Library

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION AT OLYMPIA.

The Engineer.

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SEP 26 1929

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLVIII.—No. 3844] LONDON: FRIDAY EVENING, SEPTEMBER 13, 1929 [PRICE { WITH SUPPLEMENTS } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere road, Lambeth, London, S.E. 1, invites TENDERS for—

SCHEDULE 1.—92 STRAIGHT AXLES for LOCOMOTIVES.
SCHEDULE 2.—160 STEEL TYRES for LOCOMOTIVES.
SCHEDULE 3.—PARTS for DRAW GEAR, in High Tensile Steel.

Tenders due as follows :—
Schedules 1 and 2, 20th September, 1929.
Schedule 3, 1st October, 1929.
Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each schedule.
?173

Air Ministry. DIRECTORATE OF TECHNICAL DEVELOPMENT.

A Technical Officer, Grade II., is REQUIRED at the Royal Aircraft Establishment for writing technical descriptive matter and instructional handbooks on aircraft, aero-engines and accessories. Candidates must have good engineering knowledge and experience, and a capacity for clear expression in good English; some experience in writing for publication is desirable.

Preference given, other things being equal, to ex-Service men.

Commencing salary £250, plus Civil Service Bonus per annum, giving a present total remuneration of £361 3s. per annum, on the scale £250—£20—£350, plus Civil Service Bonus per annum.

Applications should be made on a form to be obtained (quoting reference No. A.371), from the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants, to whom it should be returned not later than 2nd October, 1929.
3166

Ministry of Health. ENGINEERING INSPECTOR.

APPLICATIONS are INVITED by the Minister of Health for APPOINTMENT as ENGINEERING INSPECTOR.

The salary commences at £[illegible]00 per annum and rises by yearly increments of £25 to a maximum of £1000. In addition to the salary a bonus, which varies with the cost of living, is payable. The bonus on the minimum salary is at present £176 7s.

The appointment will carry the usual Civil Service conditions as to pension, holidays, &c.

Candidates must be Chartered Civil Engineers having had wide experience in the designing and carrying out of works, especially works of sewerage and sewage disposal. Special consideration will be given to candidates with an Honours Degree in Engineering.

Preference will be given to candidates who served in His Majesty's Forces during the war.

No candidate can be considered unless he is over thirty years of age on the 1st September, 1929.

Successful candidates will be required to devote their whole time to the public service and must be prepared to take up their duties without undue delay. The Headquarters of the Engineering Inspectors are in London.

Canvassing Members of Parliament or Officers of the Ministry will render a candidate liable to disqualification.

Forms of application, with further particulars of the appointment, may be obtained from
THE DIRECTOR OF ESTABLISHMENTS,
Ministry of Health,
Whitehall, S.W. 1.

No application will be considered unless received on the prescribed form not later than the 28th September, 1929. 3034

For Sale by the Government of ZANZIBAR, DREDGER "PENGUIN."

Pontoon type non-propelled suction reclamation dredger, complete with mooring winches and all necessary fittings, excluding discharge pipes. Fitted with two centrifugal pumps, developing 760 I.H.P., discharging through an 18in. pipe and capable of dredging to 35ft. below water level. Constructed in 1906 by Messrs. William Simons and Company, Ltd. Purchased in 1922 for £20,500.

Length, 117ft.
Breadth (over deck amidships), 28ft.
Draught, 6ft.

CONDITION.
Machinery and boilers: Very good, overhauled June, 1929.
Hull: Requires survey.

For further particulars apply to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting O/Prod. 0606; or to the TREASURER, Zanzibar. 3139

For Sale by the Government of ZANZIBAR, CONTRACTORS' PLANT in good condition, viz.:—

TWO RANSOME CONCRETE MIXERS, No. 3 size, 1921 type, with detachable elevator capable of mixing 27 cubic feet per batch. Mounted on 3ft. gauge track and driven by 22 H.P. Lister petrol engine.

ONE BAXTER STONE CRUSHER, jaw type, 16in. by 9in., No. 1169. Breaking stone to ¾in., complete with grading screen and spare toggles.

ONE GARRETT PORTABLE STEAM ENGINE, 27 B.H.P. Maximum temporary overload 32 B.H.P., working steam pressure 140 lb. per square inch, complete with usual tools.

ONE KENNEDY ROD BENDING MACHINE, capable of bending bars up to and including 1 3-8in. diameter (to 3in. internal radius).

SEVEN to EIGHT MILES RAILWAY TRACK, 3ft. gauge (30-35 lb. rail), complete with pressed steel sleepers and a number of right and left-hand turnouts.

Further particulars can be obtained upon application to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, to whom offers for the purchase of the material, quoting O/Prod. 0606, should be made. 3140

Technical Assistants.

TWO MECHANICAL ENGINEERS (unpensionable). Salary £150, rising to £230 per annum, plus Civil Service bonus, giving total at present of about £232 to £336. Candidates must be British subjects.

Age 24½-27 years. Preference and a certain age concession to ex-Service men. Possession of Degree in Engineering or certificates of equivalent examination essential; also suitable workshop training.

Application forms, returnable by 28th September, 1929, may be obtained on application to CHIEF SUPERINTENDENT OF ORDNANCE FACTORIES, Royal Arsenal, Woolwich, S.E. 18. 3138

The Engineer

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SHIPPING, ENGINEERING & MACHINERY EXHIBITION, OLYMPIA, SEPTEMBER 12th-28th.
"THE ENGINEER'S" STAND will be No. 9, ROW D, at which all our friends will be Welcome.

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PUBLIC NOTICES

Crown Agents for the Colonies. COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POST :—

M/1724.—ASSISTANT ENGINEER REQUIRED by the GOVERNMENT of the TANGANYIKA TERRITORY, for the Dar-es-Salaam Harbour, Railway Department, for a tour of 20-30 months' service. Salary, £600 a year, rising by annual increments of £30. An outfit allowance of £30 payable on first appointment. Free passages, single quarters and liberal leave on full salary. Candidates, not over 45 years of age, should be Associate Members of the Institution of Civil Engineers or hold equivalent professional qualifications, and must have had previous experience of Harbour Engineering.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/1724. 3172

Heriot-Watt College, EDINBURGH.

FULL TIME DAY DIPLOMA COURSES.
MECHANICAL ENGINEERING
ELECTRICAL ENGINEERING
MINING and OIL ENGINEERING
APPLIED CHEMISTRY and BREWING BUILDING.

AUTUMN TERM BEGINS OCTOBER 15th.

Full particulars from the College.
J. CAMERON SMAIL, O.B.E., Principal.
2609

PUBLIC NOTICES

Borough Polytechnic Institute, BOROUGH-ROAD, LONDON, S.E. 1.
ENGINEERING DEPARTMENT.

COMPLETE COURSES extending over five years of evening work, leading to the Ordinary and Higher National Certificates.

Engineering Science.
Properties and Strength of Materials.
Heat Engines.
Theory of Machines and Machine Design.
Structural Engineering Drawing.
Structural Steel Work Design.
Reinforced Concrete Design.
Heating and Ventilation.
Refrigeration.
Motor Car Engineering and Design.
Engineers' Quantities and Estimates.
Engineering Economics.
Practical Mathematics.

Enrolment, 16th, 18th and 20th September, 7 to 9 p.m.
Prospectus will be forwarded on application.
J. W. BISPHAM,
3037 Principal.

Chelsea Polytechnic, MANRESA-ROAD, CHELSEA, S.W. 3.
SPECIAL COURSES IN ENGINEERING METALLURGY.

In addition to the Courses in General Metallurgy, arrangements have been made for Special Courses of Lectures and Practical Work :—

(A) Engineering Metallurgy. Syllabus arranged to cover the syllabus of the Institution of Mechanical Engineers' Associateship Examination in Metallurgy.
(B) Heat Treatment of Metals.
(C) Testing and Mechanical Working of Metals.

The above classes are suitable for Engineers, Consultants, Engineering Students, Works Metallurgists.

COURSES BEGIN 23rd SEPTEMBER, 1929.
Full details on application,
Tel., Flaxman 0800. 3122

PUBLIC NOTICES

Northampton Polytechnic INSTITUTE,
St. John-street, London, E.C. 1.
EVENING CLASSES
IN
ENGINEERING.
All branches of Civil, Mechanical, Electrical, Aeronautical, Automobile and Radio Engineering.
APPLIED OPTICS.
Ophthalmic Optics, Optical Instrument Making, Optical Glass Working.
HOROLOGY.
FURRIERY.
APPLIED CHEMISTRY.
Fuels, Electro-plating, Metallurgy, &c.
DOMESTIC AND ALLIED SUBJECTS.
Commence SEPTEMBER 23rd.
ENROLMENTS during week commencing SEPTEMBER 16th.
Free prospectus on application to :—
S. C. LAWS, M.A., M.Sc.,
2966 Principal.

Northampton Polytechnic INSTITUTE,
CLERKENWELL, E.C. 1.
EVENING COURSES IN FUEL TECHNOLOGY AND METALLURGY.

FUEL TECHNOLOGY COURSES for Combustion and Power-house Engineers comprise :—
LECTURES on the Chemistry of Combustion and the Thermal Efficiencies of Furnaces.
LABORATORY WORK dealing with Calorimetry Fuel and Gas Analysis, the Examination of Feed Water and Allied Subjects.

METALLURGY COURSES for Engineers deal with the Extraction, Physical Properties, Commercial Application and Heat Treatment of Ferrous and Non-ferrous Metals, while the Laboratory Work includes the Microscopic Examination of these Products.

Session commences September 23rd, 1929. Enrolments, September 16th.
Free particulars on application. 3033

The University of Sheffield. SESSION 1929-30.
Vice-Chancellor: SIR HENRY HADOW, C.B.E., D.Mus., LL.D.

DEPARTMENTS OF MECHANICAL, ELECTRICAL, AND CIVIL ENGINEERING, METALLURGY, MINING, FUEL TECHNOLOGY, AND GLASS TECHNOLOGY.

The Courses in the above Departments extend over three or four years and prepare students to become specialists in one or other of these branches of Applied Science.

The LECTURE COURSES in all the Departments are supplemented by Practical Training in Laboratories and Workshops, which are fully equipped for the purpose of advanced scientific teaching, investigation and research.

Part-time Courses are arranged for students who desire to take special portions of any of the regular Courses.

In Mining Engineering and in certain of the Courses in Mechanical and Electrical Engineering, and in Glass Technology, arrangements are made to enable students who come to the University from works or collieries to take six months' Courses of study at the University and six months' practice at the works or colliery each year for a period of four years. During the first year such students should spend three terms at the University.

RESEARCH Fellowships and Scholarships are awarded annually.

The LECTURE COURSES commence OCTOBER 2nd, 1929.

The TECHNICAL LABORATORY COURSES commence SEPTEMBER 24th, 1929.

Particulars of Entrance and Research Scholarships available will be sent on application.

For further details of the Courses and for particulars of the Degrees, Associateships, Diplomas, and Certificates awarded on their successful completion, application should be made to
W. M. GIBBONS,
2923 Registrar.

Portsmouth Municipal College.
Principal: LEONARD B. BENNY, M.A. (Cantab.).
HEADSHIP OF ENGINEERING DEPARTMENT.

APPLICATIONS are INVITED for this POSITION, rendered vacant by the promotion of Mr. R. C. Prescott to a Principalship.

The Department includes all branches of Engineering (except Electrical), and also Building Trades' Courses.

Salary according to Burnham Scale, with an addition of £48.

Candidates should possess good qualifications and experience both in industry and teaching.

Full details and form of application may be obtained from the undersigned and should be returned not later than 30th September, 1929.
H. E. CURTIS,
Secretary.
Offices for Higher Education,
The Municipal College, Portsmouth. 3133

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PUBLIC NOTICES

ADMINISTRATIVE COUNTY OF LONDON.

L.C.C. School of Engineering AND NAVIGATION,

HIGH STREET, POPLAR, E.14.

Principal:
J. PALEY YORKE, M.Sc., A.M.I.E.E.

Secretary: F. N. BUTCHER.

MECHANICAL ENGINEERING DEPARTMENT.

Major courses in mechanical, marine and civil engineering, and minor courses in mechanical engineering will commence on

MONDAY, 23RD SEPTEMBER, 1929.

ENROLMENT during week commencing 16th September.

The major courses are "recognised" for the National Certificates in mechanical engineering, both senior and advanced.

Courses are provided for the examinations for A.M.I. Mech. E. and A.M.I.C.E., and for those wishing to join the Royal Navy and Royal Air Force.

Prospectus and Full particulars can be obtained from the Secretary at the School.

MONTAGU H. COX.
Clerk of the London County Council.

3036

CITY OF LONDON.

The Sir John Cass Technical INSTITUTE,

JEWRY STREET, ALDGATE, E.C.3.

Principal:
GEO. PATCHIN, A.R.S.M., M. Inst. M.M.

METALLURGY for ENGINEERS; ALSO EVENING UNIVERSITY COURSES.

The following COURSES MEET the REQUIREMENTS of ENGINEERS and those wishing to prepare for the degree of B.Sc. (Eng.) in Metallurgy of London University:—

GENERAL METALLURGY.
ELECTRO-METALLURGY.
METALLURGICAL ANALYSIS AND ASSAYING.
FUEL AND REFRACTORIES.
METALLOGRAPHY, PYROMETRY AND HEAT TREATMENT.
MECHANICAL TESTING OF METALS AND ALLOYS.
ECONOMIC GEOLOGY.

NEW SESSION COMMENCES SEPTEMBER 23RD, 1929.

ENROLMENT on and after September 16th, 5.30-8.30 p.m.

For details of the courses apply at the Office of the Institute, or by letter to the PRINCIPAL.

3039

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for :—

LOCOMOTIVE COUPLED WHEELS WITH AXLES.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Thursday, 12th September, 1929.

A fee of 10s. will be charged for each copy of the specification, which is NOT returnable.

Tenders must be submitted not later than NOON on Wednesday, 25th September, 1929.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
Secretary.

3165

Bombay Port Trust.

The Trustees of the Port of Bombay have FOR DISPOSAL the SELF-PROPELLING STEAM HOPPER BARGE "PEEWIT," with a carrying capacity of 600 tons.

The vessel was built for the Bombay Port Trust in 1910 by Messrs. Wm. Simons and Co., Ltd., Renfrew, Scotland. It is now in Bombay Harbour and is surplus to the requirements of the port.

Some particulars of the vessel are as follows :—

Length between perpendiculars, 168ft.; breadth moulded, 28ft.; depth moulded, 13ft. 6in.; draught light forward, 4ft. 11in.; aft, 9ft. 4in.; draught loaded forward, 9ft. 8in.; aft, 11ft. 4in.; gross tonnage, 536.73. Two sets compound surface condensing engines, twin screws. Designed speed 10 knots.

For further particulars apply to the CONSULTING ENGINEERS and AGENTS, Bombay Port Trust, 2, Queen Anne's-gate, Westminster, S.W. 1; and for an opportunity to inspect the vessel apply to the CHIEF ENGINEER, Bombay Port Trust, Ballard-road, Fort, Bombay. 3033

City and County of Bristol.

TO PUBLIC BATHS ENGINEERS.
BRISTOL SOUTH BATHS.

The Baths Committee of the Corporation of Bristol invite TENDERS for the ENGINEERING WORKS, comprising the Supply and Fixing of Boiler Plant, Filtration and Treatment Plant, Steam Supplies, Hot and Cold Water Services and Low-pressure Steam Heating for proposed new Public Baths at Dean-lane, Bedminster, Bristol.

Copies of the general conditions, specification, drawings and form of Tender may be obtained at this office on deposit of Five Guineas, which will be returned on receipt of a bona fide Tender.

Tenders must be made out on the forms provided, and all blanks must be filled in, otherwise they will not be considered.

Sealed Tenders, enclosed in the envelope provided, must be delivered at the office of the Town Clerk, The Council House, Bristol, not later than 10 a.m. on Wednesday, the 25th September, 1929.

In the event of any Tender being accepted the Corporation will require the contractor to provide approved security for the due performance of the contract in the sum of £500.

Preference will be given, where possible, to contractors who are on the King's National Roll.

The Corporation do not bind themselves to accept the lowest or any Tender.

By Order,
JOSIAH GREEN,
Town Clerk.

The Council House, Bristol,
5th September, 1929. 3120

PUBLIC NOTICES

Great Southern Railways.

STEEL WORK FOR BRIDGES.

The Directors are prepared to receive TENDERS for the SUPPLY and DELIVERY of approximately 225 TONS of STEEL WORK for BRIDGES, consisting chiefly of Plate Girders, Pressed Troughing and Broad Flange Beams.

Specification and drawings can be obtained on payment of £1 1s. (which is not returnable) from the Chief Engineer, Mr. J. F. Sides, M. Inst. C.E., Westland Row Station, Dublin, C. 5.

The Directors do not bind themselves to accept the lowest or any Tender.

Tenders, in envelopes endorsed "Tender for Steel Work for Bridges," must reach the undersigned not later than 5 p.m. on Monday, 30th September, 1929.

H. S. COE,
Secretary.

Kingsbridge Station, Dublin, W. 6,
September, 1929. 3129

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of—

1. ROLLED STEEL DISC WHEELS and AXLES (248 pairs).
2. STEEL BEARING PLATES for F.B. RAILS.
3. FISH BOLTS, DOG and SCREW SPIKES.
4. STEEL CRANKED FISH-PLATES.

THE TRAVANCORE RAILWAY DEPARTMENT.

5. STEEL RAILS and FISH-PLATES.
6. LOCOMOTIVE TURNTABLE.
7. DOG SPIKES, FISH-BOLTS, and NUTS.
8. STEELWORK for BRIDGES.
9. POINTS and CROSSINGS, &c.
10. STEEL BEARING PLATES for F.B. RAILS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Rolled Steel Disc Wheels and Axles," or as the case may be, with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 27th September, 1929.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specifications Nos. 1, 2, 3, and 5; and of 5s. for each copy of Specifications Nos. 4, 6, and 7; and of 2s. 6d. for each copy of Specifications Nos. 8, 9, and 10.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, of 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France,
Westminster, S.W. 1,
11th September, 1929. 3170

The Madras and Southern MAHRATTA RAILWAY COMPANY, LIMITED,

invite TENDERS for :—

251 Tons (Approx.) STRUCTURAL STEELWORK FOR EXTENSION TO CARRIAGE REPAIR SHOP (together with Bolts and Nuts, Patent Glazing, Galvd. "Armco" Flashing, &c. &c.).

Tenders are due in on Monday, 14th October, 1929, by 10.30 a.m. Tender form obtainable at Company's Office, fee One Guinea, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Office :—
25, Buckingham Palace-road, Westminster, S.W. 1.
3168

PUBLIC NOTICES

The Assam-Bengal Railway COMPANY, Limited, is prepared to receive TENDERS for :—

5 FOUR-WHEELED UNDERFRAMES, BODY IRONWORK and FITTINGS, &c. (with WHEELS and AXLES).

Specifications and Tender forms may be obtained at the offices of the Company, Bishopsgate House, 80, Bishopsgate, E.C. 2. A fee of £1 1s. is charged for each specification, which cannot, under any circumstances, be returned.

Drawings may be had at the cost of the tenderer by application to Messrs. Hodges, Bennett and Co., Ltd., 78, Queen Victoria-street, E.C. 4.

Tenders must be delivered at the Company's offices not later than Noon on Monday, the 30th September, 1929.

By Order of the Board,
M. A. RICHARDSON,
Acting Secretary.

6th September, 1929. 3123

Administrative County of LONDON.

The London County Council invites APPLICATIONS for the POSITION of PRINCIPAL of the L.C.C. Paddington Technical Institute, Saltram-crescent, W. 9, as from January, 1930.

The work of the Institute comprises :—

(I.) Junior Technical Day School for training boys for engineering and allied trades.
(II.) Day Trade School for girls preparing for trades of dressmaking, ladies' tailoring and millinery.
(III.) Evening Classes in Mechanical Engineering and Electrical Science and Chemistry.
(IV.) Evening Classes in Women's Trade Subjects.

Salary scale £820-£50-£960.

Apply, Education Officer (T. 1a), The County Hall, Westminster Bridge, S.E. 1 (stamped addressed envelope), for form, to be returned by 7th October. Canvassing disqualifies.

MONTAGU H. COX,
Clerk of the London County Council.

3157

Isle of Man Harbour Commissioners.

APPLICATIONS are INVITED for the POST (unestablished) of RESIDENT CIVIL ENGINEER, at a salary of £500 per annum, to Take Charge, under the Chief Engineer, of the Red Pier Extension, &c., Works at Douglas Harbour.

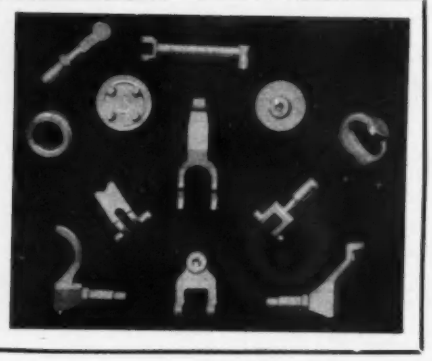
Applicants must be fully qualified Civil Engineers who have practical experience in designing and carrying out the construction of Concrete Piers, Reinforced Concrete Jetties, Dredging, &c. Experience in diving in helmet diving dress will be an advantage.

Applications, stating age, qualifications and experience, accompanied by copies of three recent testimonials, must reach the undersigned before Tuesday, September 24th, 1929.

The appointee will be expected to take up duty at the earliest possible moment after notification of his appointment.

A. W. TONGUE,
Secretary.

Harbour Commissioners' Office, Douglas,
10th September, 1929. 3158



DROP FORGINGS AND STEEL STAMPINGS

We offer proficiency coupled with a prompt service and keen price. Our modern plant and equipment is such that we can carry out repetition work with unvarying faithfulness to the original pattern, and our extensive organisation ensures expeditious despatch of quantities however large or small. We should appreciate an opportunity to quote for your next requirements.

THE HEATLY-GRESHAM ENGINEERING COMPANY LTD.,
LETCHWORTH HERTS.

HERBERT

LOW LOADER POWER TRUCKS.

Very low platform, ensuring ease of loading.
No accumulators to charge.
Is petrol driven.
Will turn in its own length.
Two forward and reverse speeds—3 and 8 miles per hour.
Exceptionally low running costs.
Capacity up to two tons.
Catalogue sheet sent on request.

DEMONSTRATIONS BY APPOINTMENT.

ALFRED HERBERT LTD. COVENTRY

PUBLIC NOTICES

Egyptian Government.

The Mechanical Department of the Ministry of Public Works, Cairo, is calling for TENDERS for the SUPPLY and ERECTION at site of Giza and Gezira Waterworks, near Cairo, of 2 DIESEL ENGINE PUMPING UNITS. Tenders are due in Cairo before Noon, 15th October, 1929.

Copies of the necessary specification and conditions of Tender are available for issue on application to the CHIEF INSPECTING ENGINEER, Egyptian Government, 41, Tothill-street, S.W. 1, against remittance of £1 0s. 6d., which sum is not returnable.

A copy of these documents is also available for scrutiny at the above address. 3149

Coimisiun na Stat-Sheirbhise.

POSITION VACANT—EXAMINER OF APPLICATIONS FOR PATENTS OF INVENTIONS.

The Civil Service Commissioners invite APPLICATIONS for the whole-time, permanent, pensionable POSITION of EXAMINER of APPLICATIONS for PATENTS of INVENTIONS (chiefly Chemical), in the Industrial and Commercial Property Registration Office, Department of Industry and Commerce. Salary scales: Married man, £150-£400; woman or unmarried man, £120-£300 a year, plus cost-of-living bonus in each case. At present the bonus on £150 is £88 16s., and on £120 is £78 8s. A candidate of approved experience may, in certain circumstances, be allowed to enter the scale at a point above the minimum, but not above £200 in the case of a married man, and not above £157 10s. in the case of a woman or unmarried man. Good general education, particularly in Science and Mathematics, and a knowledge of Industrial Chemistry required. Age limits 25 to 40 years on 1st September, 1929.

Latest date for receiving applications 19th September, 1929.—Forms and particulars may be obtained from the SECRETARY, Civil Service Commission, 45, Upper O'Connell-street, Dublin. C. 8 44/A. 4334. W. H. Co. 3117

Egyptian Government.

APPOINTMENT OF FIRST-CLASS ASSISTANT LOCOMOTIVE SUPERINTENDENT.

APPLICATIONS are INVITED for APPOINTMENT as FIRST-CLASS ASSISTANT LOCOMOTIVE SUPERINTENDENT in the Mechanical Department of the Egyptian State Railways, Telegraphs and Telephones Administration.

Applicants must be of British nationality, between the ages of 27 and 32 years, and possess the following qualifications :—

Applicants must be gentlemen of general education, strong character, tactful and accustomed to the control of men.

They must be fully qualified Mechanical Engineers, preferably holding an Engineering Degree from a recognised Engineering College or be Associates or Full Members of the Institution of Mechanical Engineers, England.

They must have served a regular pupilage or apprenticeship for at least three years' duration in mechanical engineering works of repute, preferably in the workshops of the locomotive, carriage and wagon department of a leading English, continental or American railway.

In addition to the above-mentioned training, they must have had considerable experience in the Running Department of an important railway, and be fully conversant with all details of steam shed management and locomotive allocations for various services; preferably they should have had personal charge of a large district or divisional shed.

Salary offered £E600 per annum (£E1 equals approximately £1 0s. 6d.), free of Egyptian income tax.

The appointment is subject to medical examination.

The selected candidate will be granted a transfer allowance equal to one month's salary for change of residence from England to Egypt, and also vice versa.

Period of contract 3 years.

Third-class fares and reasonable out-of-pocket expenses will be paid to applicants who are requested to attend for interview and medical examination.

Applications and specimen form of contract may be obtained from

CHIEF INSPECTING ENGINEER,
Egyptian Government,
41, Tothill-street, Westminster, S.W. 1,

to whom they should be returned with full particulars as to education, qualifications, previous experience, personal references, and COPIES of certificates or testimonials. Envelopes to be marked "First-class Assistant Locomotive Superintendent." 3148

Required for Important British-owned Railway in Argentina :—

(A) ASSISTANT WORKS MANAGER of CARRIAGE and WAGON SHOPS. Must be first-class Mechanical Engineer, good organiser and able to handle large body of labourers. Must have good knowledge of Carriage and Wagon Design and Construction. Age 30/35. Commencing salary £700 p.a., with good prospects.

(B) TWO LOCOMOTIVE INSPECTORS for the Running Section, capable taking charge of whole working of section. Age 24/35. Salary £550 p.a.

(C) THREE RUNNING SHED FOREMEN (young men who have served an apprenticeship in shops and passed out to traction service). Age 24/35. Salary £400 p.a.

(D) TWO ERECTING SHOP FOREMEN. Must be experienced men and good organisers, with thorough practical knowledge of Erecting Shop Work in all its details. Age 26/35. Salary £700 p.a.

(E) MACHINE SHOP FOREMAN, experienced in working of all classes of machines used in Locomotive Repair Shops and capable of handling men. Age 26/35. Salary £600 p.a.

(F) FITTING SHOP FOREMAN, experienced in Locomotive Fitting Work of all kinds and capable of handling men. Age 26/35. Salary £600 p.a.

(G) TWO SHOP INSPECTORS. Must have served apprenticeship and have had sufficient experience to detect and correct faulty work of all kinds on locomotives under repairs. Age 24/30. Salary £400 p.a.

(H) FOREMAN BOILER INSPECTOR, with thorough practical experience in Locomotive Boiler Work, capable of taking full responsibility for the condition of all boilers on the railway. Good prospects. Age 30/35. Salary £700 p.a.

(I) FOUNDRY FOREMAN. Experienced man required to understudy the Chief Foreman, and capable of taking full charge when necessary, of both Iron and Brassfoundries. Age 26/35. Salary £500 p.a.

Reply, stating which vacancy applied for, age, education, training and experience, whether married or single, &c., together with copies (only) of testimonials, to Box N.L.A., c/o Davies and Co., 95, Bishopsgate, London, E.C. 2. 3134

Wolverhampton Corporation WATER UNDERTAKING.

JUNIOR ENGINEERING ASSISTANT.

APPLICATIONS are INVITED for the POST of JUNIOR ENGINEERING ASSISTANT at a salary of £210 per annum, rising by annual increments of £10 to £270 per annum, in accordance with the Corporation's Salary Grading Scheme, and subject to percentage deductions in accordance with the Local Government and Other Officers' Superannuation Act, 1922. The selected candidate will be required to pass a medical examination.

Applications, stating age, qualifications and experience, together with copies of three testimonials, must be delivered to the undersigned on or before the 23rd of September, 1929.

Envelopes are to be endorsed "Junior Engineering Assistant."

B. L. McMILLAN,
Water Engineer and Manager.

Town Hall, Wolverhampton,
30th August, 1929. 3160

For continuation of Small Advertisements see pages 3 and 4.

A Seven-Day Journal

Safety of Mines Research.

THE recently issued annual report of the Safety of Mines Research Board calls attention to the desirability of a fuller knowledge of incidental underground conditions, such as can hardly be reproduced in a steel tube experiment. At the Buxton Research Station a gallery is being driven into the hillside, which will form a 700ft. tunnel 8ft. high and with a width of 8ft., in which the walls will resemble more closely those of underground workings. In this connection it is of interest to recall that in Germany the Hibernia mine at Gelsenkirchen, which up to 1927 was producing 1200 tons of coal per day, has now been set apart for research work on explosions and practical demonstrations. The value of demonstrations of explosion experiments is stressed in the report, and useful work has been done by inviting the miners and mine officials to visit the research station and familiarise themselves with the experimental work and the manner in which it is carried out. A report on the experiments on the relative inflammability of coal dust and the effect of small percentages of firedamp is in course of preparation. During 1928 ten inventions were examined by the Mechanical Appliances Committee. Only one, a tub-arresting device, was, however, considered to merit special notice. Another paper of interest is that recently published by the Board describing the experiments made by Mr. M. J. Burgess and Mr. R. V. Wheeler on the ignition of firedamp by the heat of impact of metal against rock. The experiments included full scale tests with a coal-cutting machine of the chain-type working against a built-up mass of rock enclosed in an explosive mixture.

Television.

FOLLOWING long negotiations with the Baird Television Company, the British Broadcasting Corporation has at last decided shortly to begin television broadcasts outside the present programme hours. A service is also shortly to be started from Brussels. It will be remembered that some months ago the Baird Company declined an offer of three fifteen-minute periods per week, and the new offer, which apparently covers longer and more frequent transmissions, is the result of mediation by the Post Office. The transmissions from the B.B.C. stations are to be experimental, and a necessary preliminary to regular broadcasts. The date on which the transmissions will begin and the times of transmission have not as yet been definitely settled. Definite arrangements have, however, been made for nightly transmissions from the Brussels station. At first the time of these transmissions will be from 10.30 to 11.30, but it is possible that other times will be arranged later on. As soon as the work of installing the apparatus has been completed, which should not take more than a fortnight or so, the Brussels station will begin its television service.

Trade with South America.

THE British Mission, headed by Lord D'Abernon, which left England early in August for South America, has just completed its work in the Argentine, and is now visiting Uruguay and Brazil. The reception of the Mission in the Argentine was most cordial, and, according to a Foreign Office announcement, a provisional agreement has been reached whereby within the next two years the Argentine Government will purchase about £8,000,000 worth of British manufactured articles for public works and railways in return for Argentine foodstuffs of the same value bought by this country through the usual trade channels. On leaving Buenos Aires Lord D'Abernon characterised the results as most satisfactory. There had been shown, he said, the frankest spirit of international understanding, and what was now required in Great Britain was, in his opinion, a more combined organisation, a better rationalisation, a more active representation, and a bolder outlook in view of future probabilities. The Mission includes besides Lord D'Abernon, Mr. G. E. Rowland, representing the engineering interests; Mr. Julian Piggot, the iron and steel interests; and Sir William Clare Lees, the textile trades; while other members are Mr. W. Howard Williams and Sir Herbert Gibson, who is the chairman of the British Chamber of Commerce in the Argentine. On Tuesday last the Mission left Buenos Aires for Montevideo, and will afterwards go on to Brazil.

A New Air Speed Record.

ON two of his laps in the Schneider Trophy contest last Saturday Flying Officer Atcherley, as mentioned below, attained a record speed of 332 miles an hour. This speed was a record for a straight course, let alone a closed circuit. It was estimated that, making allowances for the time lost at the twenty-eight turns which had to be effected during the seven laps, the average speed of the machine was equivalent to a straight-course speed of about 360 miles an hour. On Tuesday, September 10th, Squadron Leader Orlebar, flying the Supermarine Rolls-Royce machine on which Flying Officer Waghorn won the Schneider Trophy, made an attempt to surpass the official world's record speed on a straight course, 318½ miles an hour, established in 1927 by Major de Bernardi on a Macchi seaplane. Flying four times over the three-kilometre course, Squadron Leader Orlebar easily attained his object, his average speed being returned at 355·8 miles an hour. Just previously Flight-Lieutenant Stainforth, on a Gloster-Napier 6 machine, produced for, but not used in the Schneider Trophy race, covered four laps of the same course at an average speed of 336·3 miles an hour. The weather conditions were not wholly favourable during the attempts, and fresh efforts to establish a still higher record speed were to be made yesterday—Thursday. The timing of the laps was effected by means of a new photographic equipment designed at the Royal Aircraft Establishment. In this device a vibrating tuning fork is employed to measure fractions of seconds. It is said that the equipment gives a reading which is accurate to a twentieth of a second.

The West India Docks.

ON the afternoon of Thursday of last week, September 5th, the Union-Castle mail steamer "Llandovery Castle," of 10,609 gross tons, entered the South-West India Dock by the new lock entrance, thereby inaugurating one part of the new scheme of improvements recently undertaken by the Port of London Authority. By constructing a new entrance lock, 35ft. deep, with a width of 80ft. and a length of 590ft., compared with the 54ft. 6in. and 480ft. of the earlier lock, and providing a system of interconnecting channels, with a uniform depth of 28ft., it is now possible for larger ships to use the West India Dock system, and to pass conveniently to any desired berth. The actual water area of the new dock system is 127 acres, and the warehouse and railway facilities have been greatly improved, at a total cost of over 1½ million pounds. A noteworthy feature of the new entrance lock is the fact that large ships can use it from an hour and a half before high water until four hours after high water, whereas with the old arrangement the margin was a comparatively narrow one, and most of the entering vessels had to be berthed at high tide. It is hoped that many of the ships which previously would have hesitated to use the West India Docks, 4½ miles above the King George V. Dock, will now freely use them, and that that traffic will be brought farther up the river than previously.

Fumes from Power Stations.

IN view of the many public protests against the proposal of the London Power Company, Ltd., to construct a large power station at Battersea, the London County Council, we understand, recently approached the City of Berlin Electricity Company for information concerning its experience with smoke, ash, and sulphur fumes, at the new Klingenberg station. This station is situated at Rummelsburg, in fairly open country, on the south-eastern outskirts of Berlin, and has a designed output of 270,000 kW. The boilers are fired with pulverised fuel. In its reply to the London County Council's inquiry, the Berlin company is understood to have stated that there have been practically no complaints with regard to sulphurous fumes, and that no harmful effects, either on the health of the population or the surrounding vegetation, have so far been remarked. The coal used is, however, comparatively low in sulphur. The company points out that in a new power station to be constructed between Siemensstadt and Spandau, chimneys 400ft. in height are to be used, instead of 225ft., as at Klingenberg. Complaints have been received, on the other hand, from inhabitants and visitors to the neighbourhood around the Klingenberg station of showers of ash and grit, which are discharged from the chimneys on gusty days. In order to attack this problem the station authorities have installed ash catchers, electric dust filters, and separating cyclones, which are designed to remove about 80 per cent. of the total ash content. Further experiments are now being made with a water washing process, in which the flue gases are made to traverse several veils of water. By this means it is hoped to remove a large proportion of the fine ash which remains, and at the same time some of the sulphurous fumes. Meanwhile, the work on the preparation of the site for the Battersea power station is proceeding, and piles are being driven down to the London clay. The work is being carried out by the Foundation Company, Ltd.

New Motor Vessels for New Zealand.

AMONG the more noteworthy of the motor liners and cargo vessels which will be completed during the present year in British shipyards are the three 17,500 gross ton passenger and refrigerated cargo liners which have been ordered from John Brown and Co., Ltd., at Clydebank, for the London–Panama–New Zealand service of the New Zealand Shipping Company. As recorded in these columns on February 15th last, the first liner, the "Rangitiki," has already entered her owner's service, and her sister ships, the "Rangitata" and "Rangitane," are to be delivered before the end of the year. All these vessels are propelled by twin-screw Brown-Sulzer oil engines of 8000–10,000 total S.H.P., giving a speed of about 15 knots. It is now announced that the New Zealand Shipping Company will shortly place orders for three further ships. The actual contracts have yet to be signed, but on good authority it is understood that two of the new vessels will be built by Alexander Stephen and Sons, Ltd., of Linthouse, Glasgow, and will be propelled by Stephen-Sulzer engines. The order for the third is likely to be placed with Vickers-Armstrongs, Ltd., and the engines will be of the Doxford opposed-piston type. The new ships will each have a length of about 470ft., with a beam of 67ft. and a moulded depth to the upper deck of 40ft. The deadweight carrying capacity will be about 12,000 tons, and large refrigerated cargo space is to be provided. The propelling machinery is to have a designed output of about 9000 S.H.P., and the speed of the ships will be about 15 knots. It is expected that the new vessels will be delivered to their owners within twelve to sixteen months.

Railway Electrification.

Now that a Committee has been appointed to examine the economic and other aspects of the electrification of the railway systems in Great Britain, with particular reference to main line working, it may be assumed that sooner or later definite conclusions will be reached concerning this matter. The findings of the Committee will be anxiously awaited by the electrical manufacturers, who have long been anxious to undertake the work of electrifying the main lines. But while there are plenty of electrical engineers who believe that the scheme would pay, not a few railway men take the opposite view. Experience gained in various places abroad, where, incidentally, the conditions are more favourable for main line railway electrification than they are in this country, is not very encouraging. As recounted in a leading article, published in our issue of August 30th, long distance electrification schemes have not always proved profitable. Even in countries where there is an abundance of water power, extensions to existing schemes are being delayed on account of the high capital cost. The decision to investigate the matter in Great Britain has apparently been arrived at as an outcome of the National Electricity Scheme, which is expected to provide cheap high-tension electricity in all parts of the kingdom. But as experience in other countries shows, a cheap general supply of electricity will not ensure cheap transport. Huge sums of money have to be spent on converting the lines from steam to electric working, quite apart from the money spent on high-tension transmission lines and main sub-stations. The appointment of the Committee, which consists of Lord Weir, Sir Ralph Wedgwood, and Sir William McLintock, is not, however, surprising, for during the General Election all parties declared their willingness to assist the railways, and one of the directions in which assistance was promised was electrification. As far as main line working is concerned, however, it is doubtful if electrification would prove beneficial.

The Schneider Trophy Contest.

ON Saturday, September 7th, the tenth—or eleventh, counting the annulled meeting at Bournemouth in 1919—contest for the Schneider Seaplane Trophy was held over the Solent. Six machines, three British and three Italian, were engaged in the race. All three British machines completed the course, the winner being Flying Officer Waghorn on a Supermarine Rolls-Royce "S 6" machine, with an average speed for the seven laps of 328·63 miles an hour. Flying Officer Atcherley, on a similar machine, achieved an average speed of 325·54 miles an hour, but was disqualified for failing to round one of the marks correctly. On two of his laps he established the record speed for a closed circuit of 332 miles an hour. Flight-Lieut. Greig on a Supermarine Napier "S 5" machine produced for the previous contest in 1927 was awarded third place with an average speed of 282·11 miles an hour. Of the Italian machines, only one, a Macchi Fiat, produced in 1927 and flown by Warrant Officer Dal Molin, completed the course. This pilot's average speed was 284·2 miles an hour, and he was awarded second place. The two new Italian machines, both Macchi Isotta Fraschini aircraft and piloted by Lieuts. Cadringher and Monti, were forced by minor defects to descend on their second laps. Their speeds on the first lap were respectively 284 and 301 miles an hour. Great Britain has now won the contest four times, Italy three times, the United States twice, and France once. The Trophy becomes the permanent property of any country which wins it three times in five successive contests. This country will therefore secure it for good if we win any one of the next three contests. If Italy is to rob us of final possession, she will have to win the next two contests. America to do likewise would have to win three out of the next five contests. The final destination of the Trophy is, however, by no means as clearly indicated as these figures would imply. At one time Italy and at another time America were in precisely the same favourable position as we are to-day. It appears, too, that the great expense of competing in the contest may possibly prevent its being perpetuated. Last Saturday's race, it is said, cost the Italian Government from first to last about £1,000,000, and the British Government about £250,000.

The Shipping, Engineering and Machinery Exhibition at Olympia.

No. I.

THREE hundred and twenty-five different firms or organisations are represented at the Shipping, Engineering and Machinery Exhibition, which was opened yesterday at Olympia, London, by the Duke of Northumberland. It is the biggest of the series of such exhibitions so far organised by Mr. F. W. Bridges and his company. In our special sixteen-page Supplement accompanying this issue we give some particulars of certain of the leading exhibits. Further exhibits are described below, and in succeeding issues we hope to continue our account of the very wide range of machinery, equipment, &c., represented at the show.

GLENIFFER MOTORS.

Several examples of heavy oil, paraffin and petrol engines are exhibited by Gleniffer Motors, Ltd., Temple Works, Anniesland, Glasgow. We illustrate herewith in Figs. 1 to 3 the firm's new design of heavy oil engine. The example of this design which the company is showing is a four-cylinder 60/80 horse-power engine and is representative of two other sizes, a three-cylinder 45/60 horse-power and a six-cylinder 90/120 horse-power engine. Features of the engine and its reversing gear are covered by a number of patent applications.

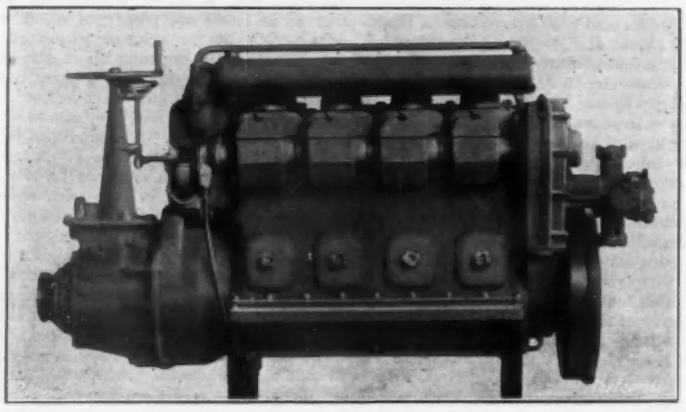


FIG. 1—60/80 H.P. HEAVY OIL ENGINE—GLENIFFER

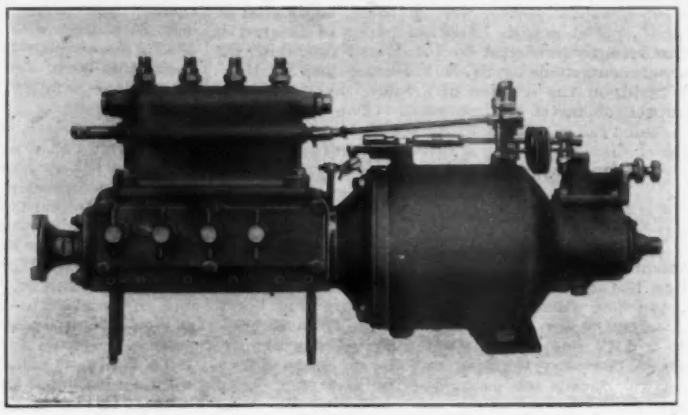


FIG. 2—FUEL PUMP UNIT AND GOVERNOR—GLENIFFER

The bottom half of the crank case, as will be gathered from the cross section shown in Fig. 3, forms the main bed-plate, while the top portion constitutes the main frame and carries the cylinder liners. The liners, of centrifugally cast iron, are completely encircled by water and can readily be withdrawn after the cylinder heads and pistons have been removed without disturbing any other parts of the engine. Each cylinder head is a separate casting secured against the upper flange of the cylinder liner by six studs threaded into the top portion of the crank case. The valves face one another in the head, the exhaust valve being on the cam shaft side and the inlet valve within a cage on the other side. The removal of the inlet valve cage permits both valves readily to be withdrawn without disturbance of the cylinder heads, the water connections or the exhaust manifold. The fuel injection valve is placed centrally in the cylinder head directly over the combustion chamber. The inlet and exhaust valves are of chromium steel. They have streamlined heads and are interchangeable.

To promote turbulence in the charge and thereby to secure efficient combustion each piston is formed with a projection on its upper end. This projection, when the piston is near its upper dead centre, enters the combustion chamber, into which the air as a consequence is projected with a high velocity. When the piston is exactly at its top dead centre its upper surface approaches very closely to the lower face of the cylinder head. Hence at this instant practically all the air is in the combustion chamber.

The timing gear is mounted at the fly-wheel end of the engine with the object of eliminating the upsetting effects of torsional oscillation in the crank shaft. The gear is driven by a duplex roller chain from a sprocket on the crank shaft. This chain, after passing round an automatic tensioning jockey support, is led over a pump-driving sprocket to the cam shaft sprocket and thence back to the crank shaft sprocket. The cam shaft mounted near the top of the upper portion of the crank case is cut from solid forgings and runs submerged in an oil bath. It operates directly on to the exhaust valves and, through pull rods, on to the inlet valves. The rocking levers are provided with adjustable screws whereby the correct clearance can be given to the valves.

There is one fuel pump for each cylinder. The pump unit and governor—Fig. 2—are mounted on the inlet valve side of the crank case. The pumps are operated by means of a cam shaft and roller tappets. A spiral recess is cut in the side of each pump plunger. Rotation of the plunger varies the position of this recess relatively to ports in the side of the pump cylinder and thereby varies the duration of the period of injection. A centrifugal governor is mounted directly on the end of the fuel pump casing and acts directly on the pump injection control. In the case of marine engines of this design a hand lever is fitted, whereby the governing speed of the engine can be varied down to 25 per cent. of the full speed. It is claimed that the speed for which this lever is set is maintained within very narrow limits whether the engine is in gear or in neutral.

The engine is started by means of a small four-cylinder compressed air motor driving through a pinion on to a gear ring on the fly-wheel. When the engine has reached a given speed the fuel pumps are thrown into action and when it begins to move under its own power the pinion is automatically thrown out of action and the air motor is stopped. The air receiver for the compressed air motor is charged from a leak-off valve on one of the engine cylinders. When the engine is running and the receiver has to be charged the fuel valve of this cylinder is cut out and the leak-off valve opened, whereupon pure air is compressed into the receiver until the starting pressure is restored in it.

The lubrication system is of the dry sump pressure feed type. A valveless oscillating plunger pump delivers oil to the main bearings through an "Auto-Kleen" strainer. The oil is carried to the main bearings through a duct drilled in the bottom of the crank case as shown in the cross-sectional engraving. Distribution pipes within the crank case are by this means rendered unnecessary. From the main bearings the oil is led to the big ends of the connecting-rods and thence through ducts to the gudgeon pins. A relief valve is fitted near the pump and from it oil is taken to maintain the oil in the cam shaft boxes at a constant level. The overflow from these boxes returns to the crank case. Surplus oil from the relief valve is taken to the timing chain and thence returns to the crank case. If the engine is intended for stationary use a sump is bolted to the bottom of the crank case, and from this sump the pump draws its supply of oil. In marine examples a separate reservoir is fitted at the after end of the engine, into which an extra scavenge pump draws the oil off from the crank case. From this reservoir the force pump takes its supply. This arrangement avoids the use of a large sump projecting below the crank case and facilitates the installation of the engine in a boat. The oil passes through a cooler between the reservoir and the force pump.

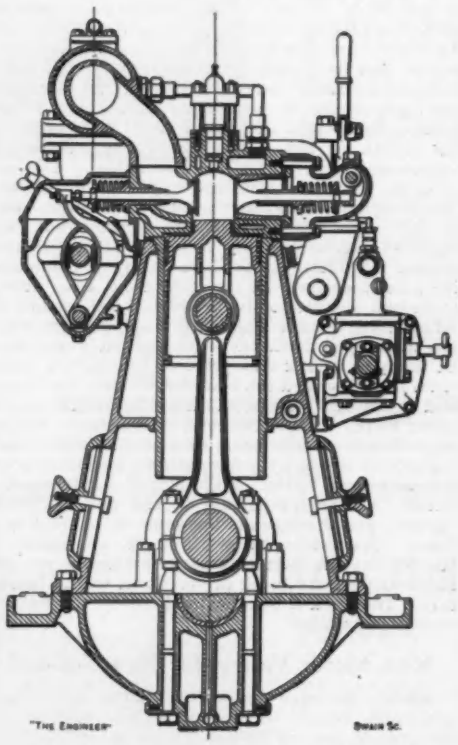


FIG. 3—SECTION OF ENGINE—GLENIFFER

In marine types of the engine the cooling water is drawn from the sea by a double-acting plunger pump. After passing through the cylinder jackets the water is taken by way of external connections to the cylinder heads and thence to the water-jacketed exhaust manifold. Thereafter it is delivered into the water injection silencer, which is of the "Gleniffer" pattern. In stationary engines a similar cooling system may be fitted or a radiator or tank in conjunction with a centrifugal pump and dry silencer may be used.

The reversing gear is of the makers' patented design. It is totally enclosed and runs in an oil bath. The ahead drive is direct and is made through a cone clutch of large diameter. The reverse drive is obtained through bevel wheels and gives the same speed astern as ahead. The whole gear is controlled from one hand wheel. The propeller thrust is taken on a large ball bearing incorporated in the reverse gear casing. Double helical single reduction gearing of 2 to 1 ratio can be fitted to the shaft beyond the reversing gear.

In all three sizes of the engine the cylinders have a bore of 6in. and a stroke of 7in., and the speed is 700/900 r.p.m. The fuel consumption with oil of 0·89 specific gravity is guaranteed not to exceed 0·44 lb. per B.H.P. hour at any load from three-quarters to full.

HENRY HUGHES AND SON, LTD.

Two of the principal items of interest on the stand of Henry Hughes and Son, Ltd., 59, Fenchurch-street, E.C. 3, are the Holmes magnetic master compass and path indicator. The Holmes compass is a magnetic master compass designed to operate any number of repeater compasses at distant stations. The path indicator is an instrument intended to show how far a ship has deviated from the course laid down by her navigator. It is mounted in combination with a repeater compass and is claimed to enable the quarter-master at the helm to keep the ship on the actual track laid down on the chart.

The Holmes compass mounted in its binnacle and dismounted therefrom is shown in Figs. 4 and 5. Like a normal standard magnetic compass, it is provided with a full set of correction gear, and is compensated in the usual manner. The magnetic element has a standard card and is pivoted in a bowl filled with a non-freezing liquid. The principle on which the repeaters are operated is claimed to be entirely new. An electrical relay controls the repeater switches, the relay, in turn, being controlled by the variation of the electrical resistance of two liquid paths for current within the bowl. The paths referred to lie between conductors fixed to the bowl and conductors attached to the float of the magnetic element. The four bowl conductors are led in through insulator tubes and are spaced equally round the bowl. Their ends are bare and vertical. The card conductors consist of two parallel wires covered with insulating material, except at their ends, which are exposed and bent into the vertical. As arranged, the card can rotate freely, the respective conductors passing each other with a clearance of about $\frac{1}{16}$in. An extra wire is mounted inside the bowl as a lubber line.

When the north point on the card is opposite the lubber line, the card conductors are opposite the bowl conductors, and the two electrical paths—bowl, card, bowl—are of equal electrical resistance. The

currents flowing through these two paths are led to a differential relay which operates either of two switches as soon as the electrical balance is disturbed by the rotation of the card. The two switches control a reversible electric motor connected through reduction gearing to a frame carrying the compass bowl. Immediately, therefore, the card moves a fraction of a degree in either direction, the relay operates one of the two switches, the motor is started and the bowl is turned in the same direction as that in which the

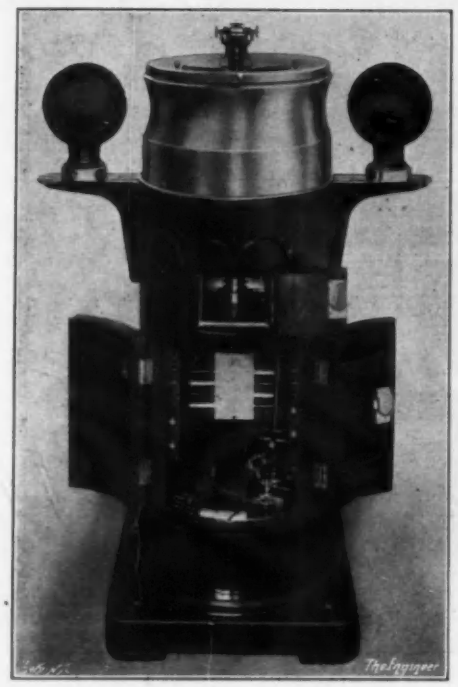


FIG. 4—HOLMES MAGNETIC COMPASS—HUGHES

card has begun to move. When the bowl has turned through the same angle as the card, the resistance of the two electrical paths again becomes balanced, the relay opens the switch and the motor stops.

The repeaters are operated by a transmitter connected to the reduction gearing between the motor and the compass bowl. The frame of the bowl carries a divided circle, which, reading against a fixed arm, indicates the ship's course. The repeaters show the same indication as the divided circle. The lubber

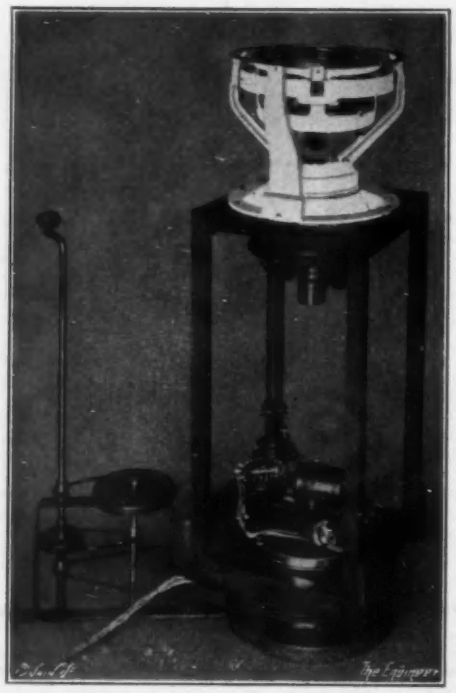


FIG. 5—HOLMES COMPASS DISMOUNTED—HUGHES

line wire inside the bowl rotates with the bowl, and enables the navigator to see that the bowl follows the card exactly.

In the event of a failure of the current, the compass can be arranged to act as an ordinary magnetic compass, although it can no longer operate the repeaters. Should the current fail, the connection between the motor and the frame carrying the bowl is broken by unscrewing a pin in the reduction gear transmission. The compass bowl and its frame are then rotated until the lubber line is lying fore and aft. In this position the bowl is locked by inserting a screw through a hole below the zero of the divided circle into a hole in the support carrying the fixed reading mark.

The motor in the base of the binnacle runs on alternating current in order that the magnetic element of the compass may not be affected by any electromagnetic influence. For the same reason alternating current is also used for circuits passing through the bowl.

It is pointed out that since the Holmes compass can operate repeaters, it can also be used to operate course recorders, automatic pilots, and other devices which require the transmission to them of the indications of the compass.

The Holmes path indicator is an instrument designed to help the steersman to keep his ship on her prescribed track, and to eliminate the cumulative error produced by the yawing of the ship under the influence of wind and sea. When a ship yaws and is brought back to her correct heading she must inevitably be some little distance to one side of the track which she was following before she yawed. With each yaw the departure accumulates. A particularly skilful steersman may roughly correct the departure by allowing the vessel to come off her true heading for an interval of time on the side opposite to that to which she has yawed. The correction required is, however, a matter of guesswork. The Holmes path indicator eliminates this element of guesswork by providing an actual reading representing the departure at any instant to one side or the other.

The instrument embodies a repeater compass dial, provided with a radial pointer which can be set to the course which the ship is to follow. It also has a dial with two scales and two hands, which, moving to the right or left, indicate the departure in the corresponding direction of the ship from the track, as set by the radial pointer of the repeater compass.

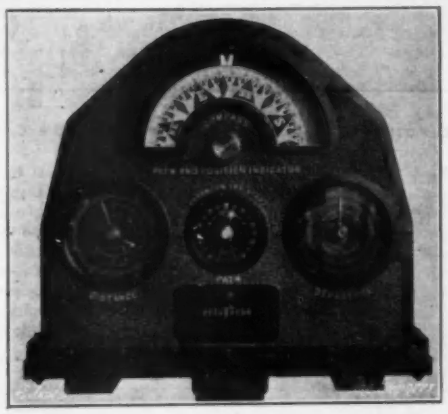


FIG. 6—PATH AND POSITION INDICATOR—HUGHES

The actual departure in miles is determined by multiplying the reading of the dial by the ship's speed in knots. If the departure is small, it is indicated by the movement of the large hand against the outer scale. If it exceed that which can be shown by half a revolution of this hand, it is indicated by the small hand against the inner scale. It is, therefore, possible to run the ship deliberately off her set track for considerable distances and afterwards to bring her back to it with precision. The action of the instrument is obtained by the automatic integration with respect to time of the sine of the angle between the radial pointer and the lubber mark of the repeater.

The principle of the path indicator has been applied to another instrument, the path and position indicator—see Fig. 6—which shows not only the departure to the right or left of the prescribed course, but the distance run along that course.

NEGRETTI AND ZAMBRA.

Of the various instruments that Negretti and Zambra are exhibiting, the photographic temperature recorder for cold chambers, shown in Figs. 7 and 8, is perhaps the most interesting. Experience with ordinary recording thermometers for ship's refrigerated holds has indicated that these instruments are not always satisfactory. Frequently large sums of money depend on the thermometer readings, which, in the event of a dispute, should give no reason for doubt. While the usual types of recording thermometers give excellent results if properly looked after, owing to various causes the readings may not correspond with those of a standard certificated mercury-in-glass thermometer, and consequently they may not always be accepted by a court of law. An instrument has therefore been developed that photographically reproduces the readings of a standard mercury-in-glass thermometer placed in the hold. Besides this thermometer, the scheme involves the use of a counter, two electric lamps, a camera, an electric motor, electric control mechanism, and an electric control clock, to be seen in Fig. 7. The thermometer and counter are mounted on a base board protected by a cover, and are placed inside the chamber in which the temperature is to be measured. By means of an electric cable, they are connected to the electric control clock, which is fitted outside the hold. Batteries or the ship's lighting circuit may provide the supply.

The thermometer is mounted by the side of the counter on a metal standard, with vertical adjustment, so that the thermometer may be adjusted to the centre of the camera field, as necessary. The standard carrying the thermometer is mounted at one end of the baseboard in front of the camera, whilst on each side of the lens there is an electric lamp, as shown in Fig. 8, from which it will be gathered that the camera is fitted with an extension for carrying a roll of cinema film. In the space between the camera and the thermometer, the motor and control mechanism are placed. Through the

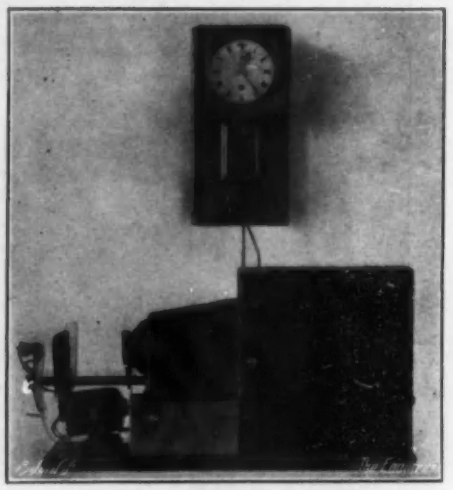


FIG. 7—PHOTOGRAPHIC TEMPERATURE RECORDER—NEGRETTI

control mechanism the motor operates the counter, the electric lamps, and the shutter of the camera; it also winds the film. The clock, placed outside the chamber, controls the cycle of operations. Every twelve hours—*i.e.*, at 9 a.m. and 9 p.m.—electric contacts close the circuit. A length of film is then wound into position, the thermometer is illuminated, the shutter operated, and the counter advanced a tooth. The light is then cut off and the cycle of operations completed. In order to give the time scale, the counter is shown on each photograph at the side of the thermometer tube. The film employed is a standard cinema film, used lengthways, and the size of the object on the negative is slightly larger than the actual size. The length of each image is 4in. and for a 60-day voyage with two photographs a day and a ¼in. blank between the photographs a 30ft. film is required.

The advantages of the scheme may be summarised as follows:—(*a*) A certified mercury-in-glass thermometer is accepted as a standard of reference for the most accurate indications of temperature. (*b*) The National Physical Laboratory will certify the accuracy

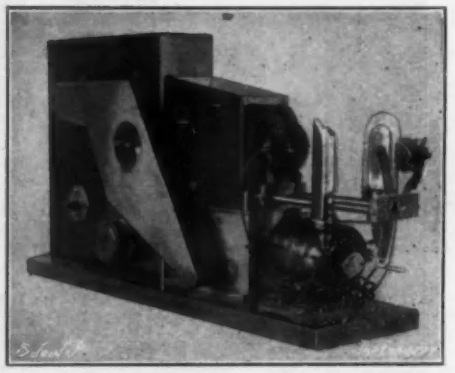


FIG. 8—PHOTOGRAPHIC TEMPERATURE RECORDER—NEGRETTI

of such a thermometer to 0·1 deg. Fah., or, if necessary, to finer limits. (*c*) The thermometer has a scale which does not change, it being etched on the glass tube, together with the N.P.L. monogram. (*d*) An actual photograph of the thermometer is provided, together with the number of exposures. (*e*) The exposure number which is photographed, together with the thermometer, is a series number from which the time and date of the exposure may be ascertained. (*f*) The photograph provides conclusive evidence acceptable to a court of law.

J. AND E. HALL, LTD.

The two main exhibits on the stand of J. and E. Hall, Ltd., of Dartford Ironworks, Kent, are high-speed vertical carbon dioxide (CO_2) and ammonia (NH_3) compressors, arranged for direct motor driving. These machines are illustrations of the new tend-

encies in marine and also land refrigerating practice referred to by Mr. H. J. Ward in his paper on "Refrigeration on Shipboard," which was read at the last annual meeting of the Institution of Mechanical Engineers, and reprinted in our issue of February 22nd last.

The vertical enclosed single-acting CO_2 compressor shown in the two views reproduced in Fig. 9 is shows the valve head connections and control valves which provide for different working conditions. In the other view the double inspection doors may be noted, the large doors being designed to give access to the reciprocating parts for inspection and repair, and the smaller top doors to the compressor sealing glands. At the end of the crank case opposite to the fly-wheel is the main lubricating oil pump, while on

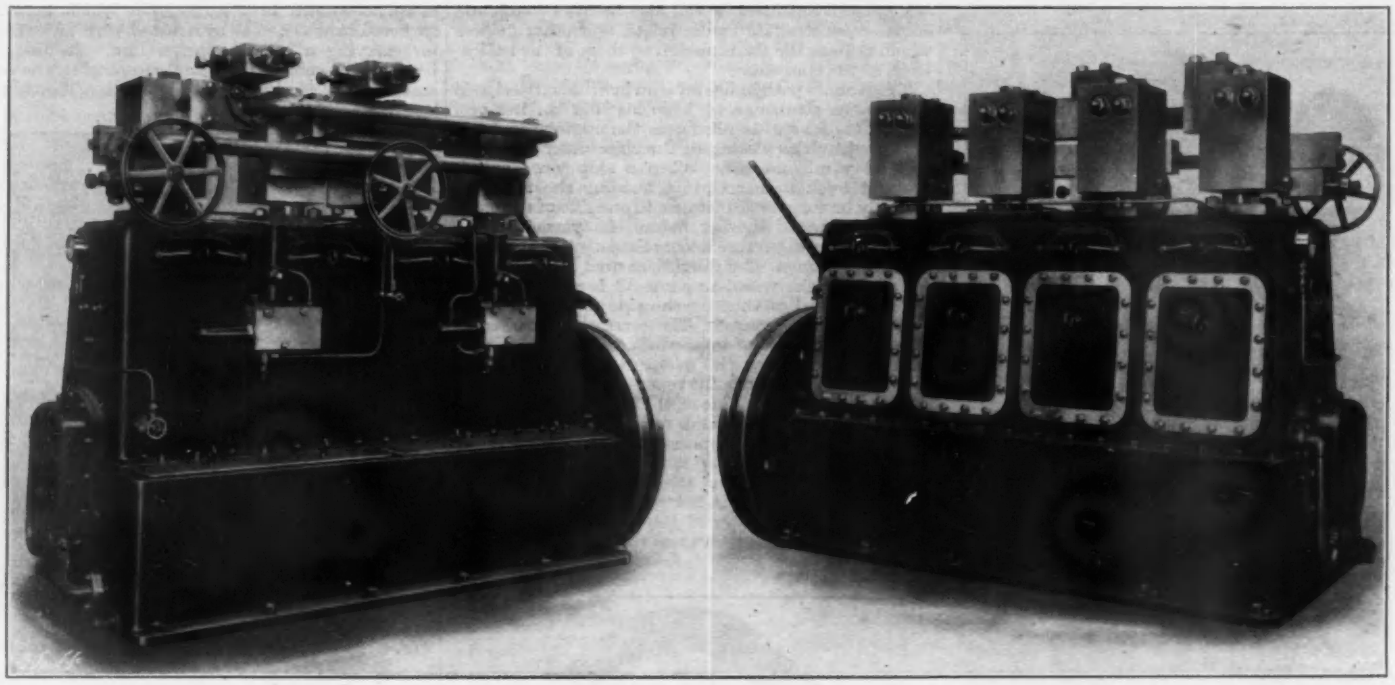


FIG. 9—SINGLE-ACTING CARBON DIOXIDE REFRIGERATION COMPRESSOR—HALL

one of several four-cylinder units recently supplied for a large motor vessel operating in the meat-carrying trade. It has a cylinder bore of 3⅝in. and a stroke of 7in., and is designed to operate at speeds up to 375 r.p.m., the driving motor having an output of about 165 B.H.P. Although high-speed steam engine practice has been closely followed in the design of the reciprocating parts, some modifications were called for in the proportioning of the bearing surfaces, on account of the special quality of refrigerator oil which is employed for lubrication throughout on the pressure system. The main bearings have larger surfaces than usual, and the whole of the running gear is enclosed in a substantial bed-plate and crank casing. The valve head blocks are made in forged steel, and they are furnished with a bottom flange, which is bolted directly to the top of the crank case. The left-hand engraving clearly

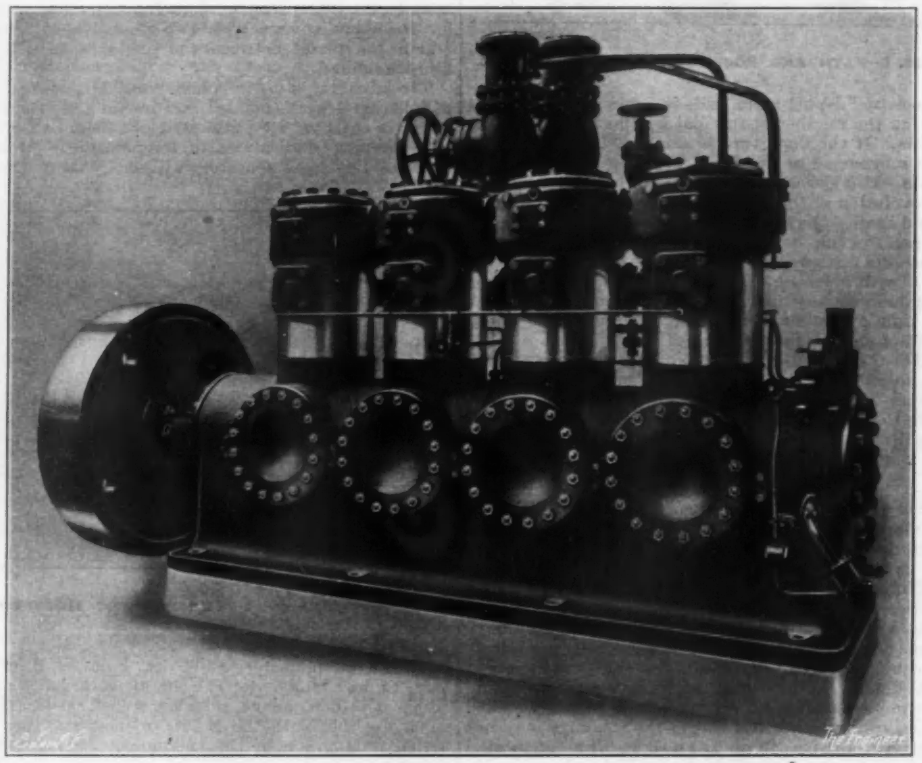


FIG. 10—HIGH SPEED AMMONIA COMPRESSOR—HALL

the front of the crank case, as shown in the left-hand engraving, there are arranged two oil sealing pumps. Below these pumps on the top of the bedplate are removable inspection doors, giving access to the interior of the bedplate. The fly-wheel is furnished with a hand barring gear and between the compressor and the driving motor a flexible coupling is inserted.

In contrast with the carbon dioxide compressor we have just described is a large four-cylinder ammonia (NH_3) compressor of the vertical enclosed electrically driven type, which we show in Fig. 10. The crank shaft and connecting-rods are enclosed in a gas-tight crank case, upon which the compressor cylinders are mounted, with their steel water jackets. There is only one crank shaft gland at the fly-wheel end of the machine, and this is fitted with a self-aligning attachment. The cylinders each have a bore of 10½in., with a stroke of 8½in. and the running speed of the 220 B.H.P. driving motor may be about 375 r.p.m. maximum. The delivery valves are accommodated in the cylinder heads and a spring controlled safety head is fitted which relieves any excess pressure which might be caused when, owing to improper regulation, a sudden rush of liquid ammonia enters the machine. The pistons are of the trunk type, with the main rings above the gudgeon pin and scraper rings below it. Both the delivery and suction valves are of the plate type, the delivery valves only being spring loaded. The gas is taken in through a suction port in the side of the cylinder, and enters the body of the piston through large ports in the walls. It passes into the cylinder through the suction valve in the piston head on the downward stroke, and is discharged through the delivery valve on the upward stroke. The oil pump is driven from the end of the crank shaft, and is housed within the crank case, access being given to it through an end inspection door. It may be noted that the hand wheels of the main suction and delivery stop valves shown above the compressor in Fig. 10 are overlapped in such a manner that the suction valve

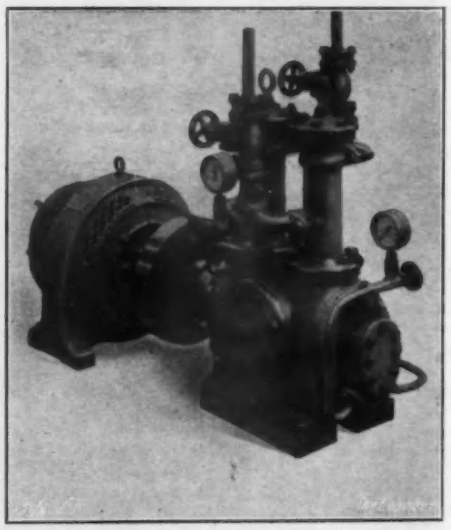


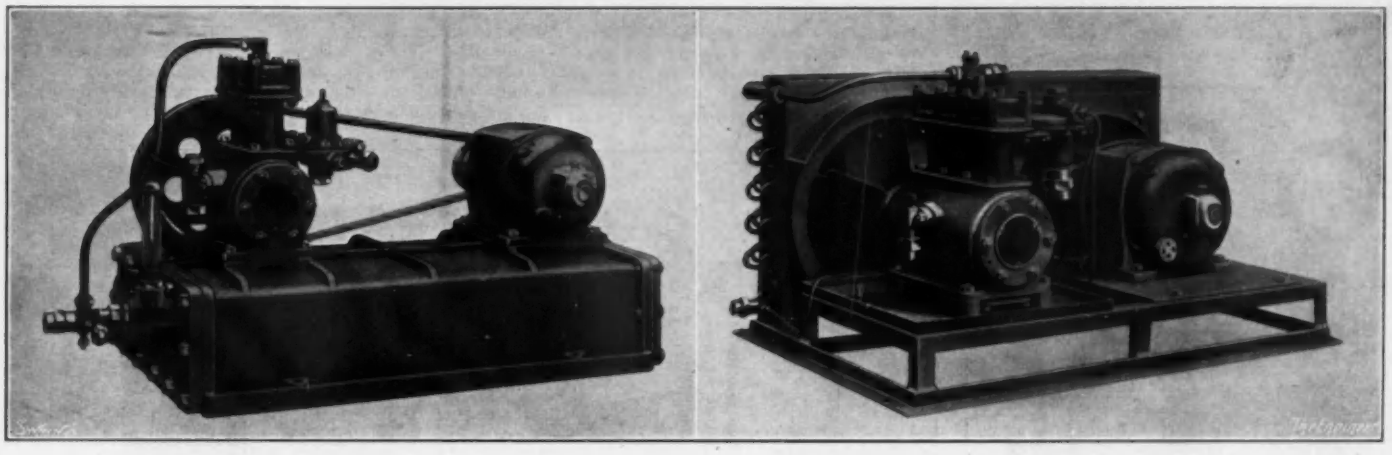
FIG. 11—TWIN CYLINDER AMMONIA COMPRESSOR—HALL

cannot be opened without first opening the delivery valve.

A new type of ammonia machine which has recently been designed for the larger sizes of automatic refrigerating installations is that known as the "No. 6 Wembley" machine, which we illustrate in Fig. 11. This unit follows as regards its reciprocating parts general high-speed engine practice, and trunk pistons are fitted. The whole of the unit is lubricated by a forced feed system, the oil being furnished by a direct-driven pump accommodated on the end of the bed-plate. There is a small fly-wheel fitted between the compressor and the driving motor. The crank shaft gland is of the "Cooke seal" pattern, and good access for inspection is given. A large circular door on the crank case gives access to the running parts.

In front of the twin cylinders a separator with automatic control valves is arranged.

In Figs. 12 and 13 we show two examples of the firm's new "Hallmark" automatic electrically driven methyl-chloride plants. These models are built in single, twin, and triple cylinder units, requiring ½, ¾ and 1 B.H.P. motors respectively. For marine work, water-cooled condensers arranged in the base quality, the main poles being of laminated construction. The field coils are specially insulated. The armature and commutator are mounted on separate spiders, pressed and keyed on the shaft. The brush gear has holders of the sliding box type. The pedestal bearings of the machine are lined with white metal and are lubricated by double oil rings. Special arrangements are made to prevent oil creeping along the shaft. cages facilitate the work of grinding-in the valves, and when the cages are removed, large openings afford good means for inspecting the cylinder and for decarbonising when necessary. The fuel pumps, one to each cylinder, are arranged on top but to one side of the cylinder, and are operated by straight push rods from the fuel cam on the cam shaft. The spraying takes place through a specially designed sprayer valve



FIGS. 12 AND 13—AUTOMATIC ELECTRICALLY DRIVEN METHYL-CHLORIDE REFRIGERATION COMPRESSORS—HALL

are employed, while for land work air-cooled condensers are available, if desired.

The model illustrated in Fig. 12 represents a twin-cylinder marine type unit, which is being supplied in large numbers for passenger and cargo vessels and yachts. It will be seen that the compression unit with its automatic valve control is

The engine has a normal rating of 137 B.H.P. It is of the cold starting type, and it operates on cheap grades of fuel oil. All the moving parts are completely enclosed and supplied with forced lubrication. Thermometers are provided at each exhaust pipe, and at each outlet branch for the cooling water, whereby the attendant can readily ascertain that each

situated in the centre of the cylinder between the inlet and exhaust valves.

It is claimed that the horizontal enclosed engine is specially adaptable for placing between decks where the available headroom is small, and although the engine is enclosed, the parts within are easy of access by lifting the crank shaft covers, when the connecting-

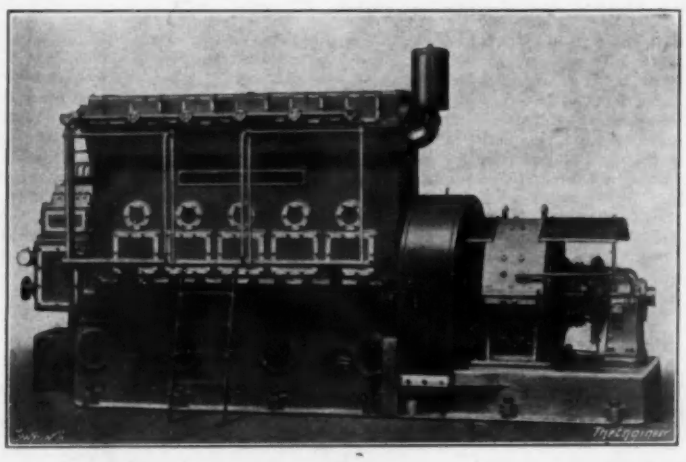


FIG. 14—FIVE-CYLINDER VERTICAL HEAVY-OIL ENGINE—CROSSLEY

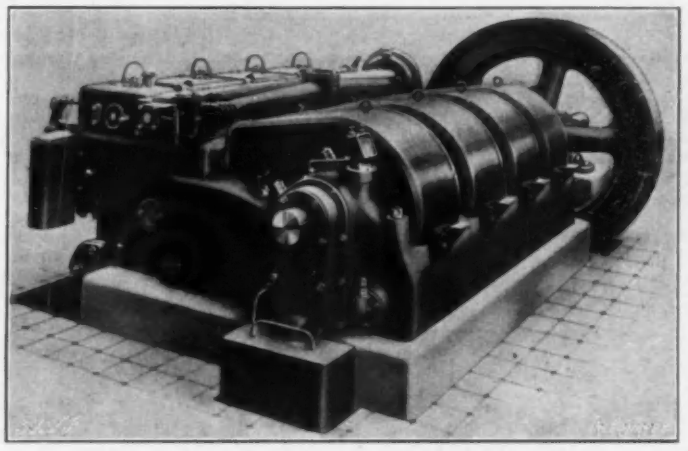


FIG. 15—FOUR-CYLINDER HORIZONTAL HEAVY-OIL ENGINE—CROSSLEY

mounted on the top of the condenser base, and is belt driven by a motor. The cylinders are provided with safety heads, and the bearing surfaces are generously proportioned. The machine works on the direct-expansion principle, and the cooler—which we do not show—is composed of copper tubes soldered throughout their length to galvanised steel plates. The other part of the apparatus consists of an automatic electric control gear working in conjunction with a thermostat. Various types of cold chambers and cabinets can be supplied to meet the different requirements of large ships, small vessels, and yachts. The view reproduced in Fig. 13 shows a similar machine of the three-cylinder type, which is furnished with an air-cooled condenser. In this unit the motor and compressor are mounted on steel stays, which form part of the general framework of the machine and condenser.

CROSSLEY BROTHERS, LTD.

On the stand of Crossley Brothers, Ltd., Openshaw, Manchester, there are two examplets of modern heavy-oil engines—one a new type of vertical, and the other of the horizontal enclosed type. It is claimed that both engines are specially suitable for marine purposes.

The principal exhibit is the five-cylinder vertical compressorless heavy-oil engine—illustrated in Fig. 14. It is shown in working operation direct-coupled to a Metropolitan-Vickers 90-kW 220-volt compound wound electric generator, the whole being mounted upon a substantial under base plate. This combined unit operates at 450 r.p.m., and as a marine auxiliary is suitable for electric lighting, or to supply current to operate motors for winches, pumps, &c. The Metro-Vickers generator is of special construction, the yoke being of rolled section of high magnetic quality. The poles are likewise of high magnetic working cylinder is taking its proportionate share of load, a matter of considerable importance with multi-cylinder oil engines. The fuel pumps for the vertical engine are grouped together in one unit, arranged at one end of the engine, which makes a very accessible and compact arrangement. The overhead valve gear is entirely encased—the inlet and exhaust valves being operated directly from valve levers without the introduction of push rods. The cam shaft, with its cams, is likewise overhead and enclosed, being driven by a silent roller chain, fitted with adjustment gear, which in no way disturbs the valve timings. Starting up is effected by compressed air applied to all five cylinders, which gives rapid acceleration at starting and ensures the engine being put into action at full speed within a few seconds.

Fig. 15 illustrates the Crossley new type enclosed horizontal four-cylinder oil engine. This engine has a normal rating of 80 B.H.P., at a speed of 375 r.p.m., and operates on cheap grades of fuel oil. It is started up from cold by means of compressed air. All parts are enclosed and protected, and copious lubrication is provided from a pressure oil pump which delivers the lubricating oil into container boxes, each having a visible outlet that supply streams of oil to the main bearings and connecting-rod bearings. The oil, after passing through the bearings, is returned to a sump where it is filtered and used over again. The usual sideshaft and its gear wheels are abolished on this engine, and instead a silent chain is employed to drive the cam shaft, which is enclosed in a housing arranged across the top of the engine. All the cams operating the valves revolve in a bath of oil. The chain is encased and also moves in an oil bath.

The inlet and exhaust valves are contained within separate removable cages situated in the cylinder head, and are operated from straight push rods acting directly upon the valve levers. The separate valve rods and pistons are easily accessible for inspection purposes.

THE ELECTRIC SUBMERGED LOG COMPANY.

Once again this company, which has exhibited its products at many previous Exhibitions, is showing the Chernikeeff electric submerged log, as used in the British, French, Dutch, Italian, Japanese, Greek, Norwegian and other navies, and on various cable ships, merchant ships, and on yachts. Three types of these electric logs are shown. The No. 1 type has

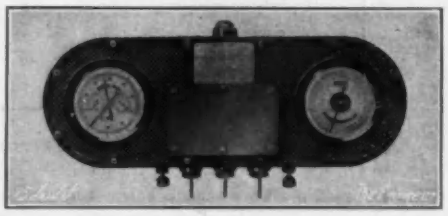


FIG. 16—MASTER INSTRUMENT—SUBMERGED LOG

a distance recorder registering every 15·2ft., or every 400th part of a mile, and a separate speed indicator indicating every half knot from 0 to 40 knots, together with distance recorder and speed indicator repeaters, a courseograph relay, and a speedograph, which gives a continuous record of the vessel's speed. The master nstrument of this No. 1 log is shown in Fig. 16 whilst Fig. 18 shows the hull fitting, a speed indicator repeater, a distance repeater recorder, a speedograph, and relay. All three types of the Chernikeeff log are constructed on the same principle. The sub-

merged mechanism, which is hermetically sealed in an oil-filled chamber 15—Fig. 17—is actuated by an impeller. All this mechanism has to do is to make contact between platinum points on two small contact springs operated through worm gearing working in an oil bath. Thus, the only resistance the impeller has to overcome is that of these two springs. A ball thrust bearing takes the pressure of the head of water on the impeller. Thus the mechanism has no appreciable frictio or noappreciable work to perform, and consequently the impeller has no appreciable slip. On account of this feature, extreme sensitiveness is attained. Distance can be registered at the lowest, as well as the highest speeds, without correction allowances or the insertion of additional gears. Each time a contact is made in the submerged mechanism, an electric impulse is transmitted to the distance recorder, where the current energises coils which operate the mechanism. The division is registered on the dial for each impulse received. The speed indicator mechanism of the No. 1 log consists of two parts, a time unit and a distance unit, which work in conjunction with each other and give the speed, and they are both fitted in a waterproof case situated in the chart-room. Any number of distance recorder repeaters and speed indicator repeaters can be worked by the master instrument—shown in Fig. 16. They can be fitted in any desired part of the ship, and worked in conjunction with a gyro compass course recorder for recording distance run on a course, and a speed recorder registering the speed on a moving chart throughout the twenty-four hours. The current for working the log and repeaters, &c., is derived from a 20-volt accumulator, which is maintained in a charged condition by the ship's lighting circuit.

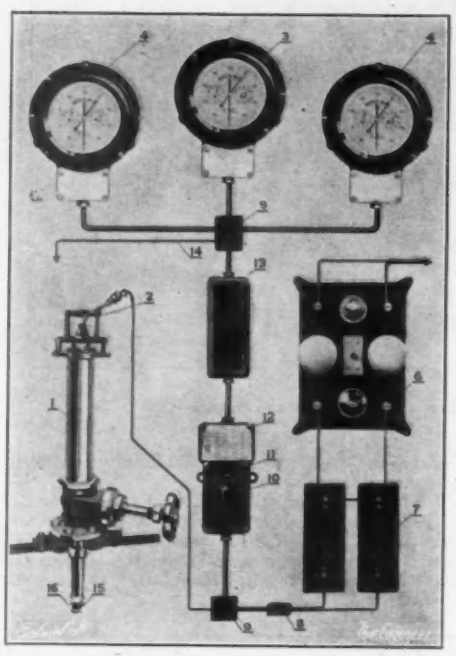


FIG. 17—HULL FITTING, ETC.—NO. 2 SUBMERGED LOG

The numbers 1 to 16 in Fig. 17, which shows the general arrangement of the No. 2 log, with two repeaters, indicate the following parts:—1, hull fitting; 2, log; 3, distance recorder; 4, repeaters; 5, cables to dynamo; 6, charging board; 7, accumulator; 8, fuses; 9, branch boxes; 10, switch; 11, flash lamp; 12, speed tables; 13, relay; 14, cable to course recorder; 15, submerged mechanism; 16, impeller.

The No. 3 type log, Fig. 19, has been introduced for use in the mercantile marine, &c. The distance recording instrument is fitted in an aluminium alloy case situated in the chart-room, and registers every twentieth part of a mile, the dial being calibrated up to 10,000 miles. The hands can be re-set at any time. Below the indicator dial is a speed table which gives speeds up to 40 knots, whilst below this table there is an electric flash lamp. If the time is taken by a stop watch between the commencing or finishing phases of two consecutive flashes, the speed can be read directly from the speed table. The log is similar to the No. 1 type log. The rotor makes 225 revolutions for every contact made every twentieth part of a mile, the gear ratio being 225 to 1. The submerged part of this log, as well as that of the types 1 and 2, can easily be removed for inspection and oiling. As the submerged part of the log is well below the surface of the water, it is clear of all floating obstructions. It is said to be unaffected by pitching and rolling. The Chernikeeff log is guaranteed by the makers to record the distance to 0·5 per cent. and indicate speed to half a knot under all conditions of weather or draught and at any speed from half a knot to 40 knots.

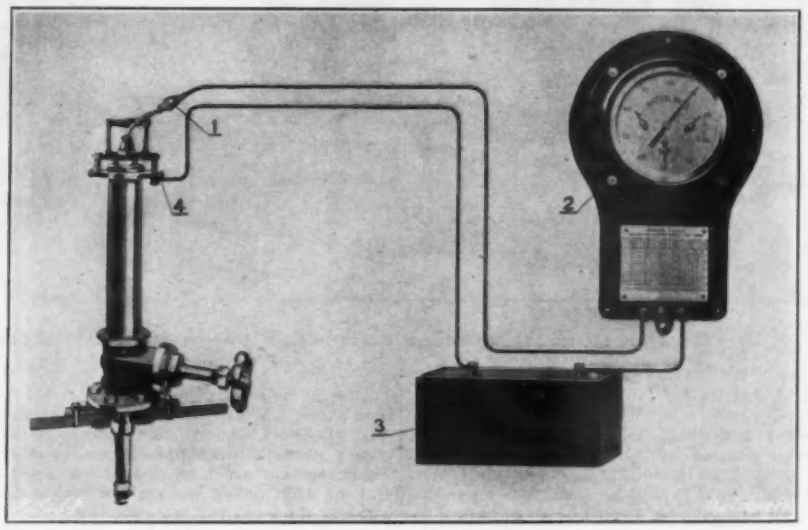


FIG 19—HULL FITTING AND RECORDING INSTRUMENT—NO. 3 LOG

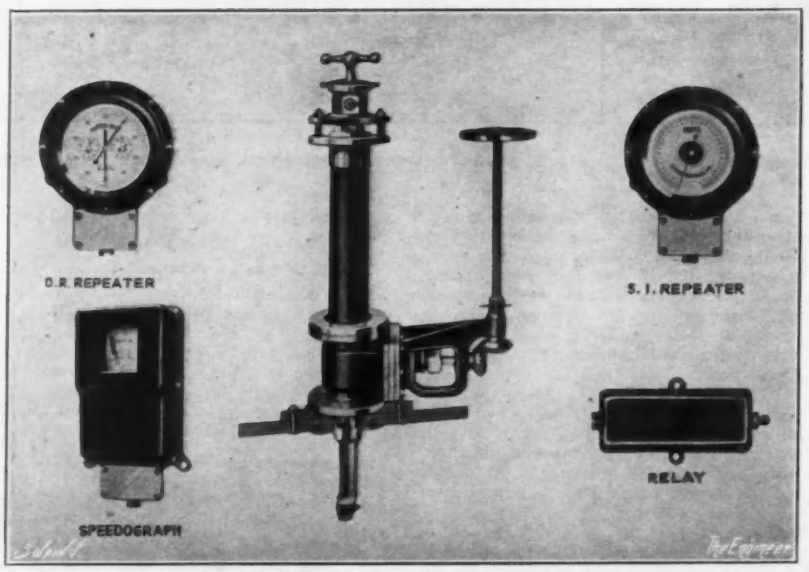


FIG. 18—HULL FITTINGS, ETC. FOR NO. 1 LOG

THE STREAM-LINE FILTER COMPANY, LTD.

THE Stream-Line Filter Company, Ltd., of 45, Horseferry-road, Westminster, is exhibiting, in operation, a range of filters for the reconditioning of used lubricating oil, of which we illustrate one example in Fig. 20.

This apparatus, it will be seen, is of the self-contained type, and is suitable for dealing with the oil used in a high-compression oil engine of from 150 to 400 brake horse-power. The principle of the stream-line filter is so well known to our readers that it is unnecessary to describe it in detail here. It is sufficient to say that the essential elements of the filter is a pack of fibrous discs, which are perforated to provide passages for the oil and are clamped tightly together. The oil passes through the discs edgeways, and all traces of solid impurities, even including colloidal carbon are removed. It will be noticed that the filter chamber is provided with two wing extensions, in which there are electric heating elements for warming up the oil. The filter requires no more attention than the periodic operation of a single control lever, which puts in action the cleaning process, effected by means of compressed air.

It is noteworthy that marine engineers have not hitherto widely adopted the filter for ship use, but satisfactory equipments have already been in service for over twelve months in the motor vessels "Santa Maria" and "Santa Barbara" (each 8000 B.H.P.), whilst one oil company has put down two riverside plants to deal with oil from vessels in which after the lapse of many months it has reached an unsatisfactory condition in spite of all other methods of treatment.

Another interesting feature of the exhibit is the complete reproduction of the interior arrangements of a filter house installation along the lines of that supplied to the Central Electricity Board for the Central Scotland scheme, for service in reconditioning switch and transformer oils. Every trace of colloidal carbon and moisture is said to be removed by the process. Thirteen transforming stations in Scotland are being equipped with oil storage and purifying plant by the company, the control and filter plant in each case being accommodated in a centrally placed house. The equipment which is shown in actual operation at Olympia is of 300 gallons per hour capacity, with oil transfer pumps of 1000 gallons per hour capacity, and used oil is delivered with a breakdown voltage considerably in excess of the 45 kilovolts specified, without any necessity for the use of chemical treatment or blotter presses.

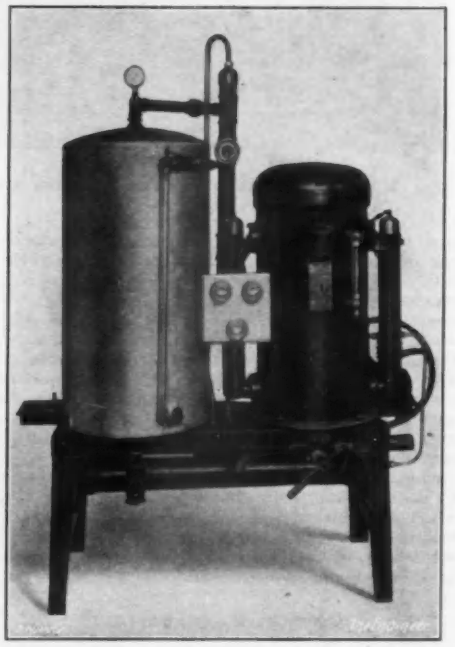


FIG 20—STREAM-LINE FILTER FOR OIL

(To be continued.)

Fusion-Welded Pressure Vessels.

THE Technical Report for 1928 of the British Engine Boiler and Electrical Insurance Company, Ltd., of Manchester, is almost wholly devoted to the subject indicated in the title of this article. The Report is published at the price of 7s. 6d., and as it represents the first attempt in this country to reach definite recommendations with regard to the manufacture and use of welded vessels for high pressure, it is certain to attract considerable attention. It may lead to the circulation of official regulations, the issue of which cannot long be delayed. Welded high-pressure steam drums are being used on the Continent, but their employment here is, we believe, discountenanced by every one of the boiler insurance companies. The authors of the present Report say categorically that the riveted joint is preferable to the welded joint, and that the welded pressure vessels produced on the Continent would not be accepted in this country. Yet "though there certainly are elements in welding that are far from desirable, the disfavour with which welding is sometimes regarded is in a large measure due to the lack of control in matters of design and manufacture, whereas with vessels made to rigid regulations the undesirable elements would largely disappear." Furthermore, "in view of the fact that welding is often the most economic method of making a joint, and that it is a convenient means of obtaining tightness, a welded joint is entitled to consideration as an approved form of construction for an unfired pressure vessel, provided that it is properly designed and constructed."

The Report occupies over 120 quarto pages of text and is accompanied by numerous illustrations and tables. The immediate object of the investigation which it records was to obtain sufficient knowledge on which to decide what construction should be permitted for pressure vessels and what limitations, if any, should be set. The investigation involved the making of many hundreds of mechanical tests, and was limited in the main to vessels designed for gas or air pressure.

The following abstracts may give some idea of the contents of the Report:—

A statement that a joint of a particular form has a given strength is of little value, for a butt weld made by one process may have a strength of 20 tons per square inch, but when made with another welding rod or by a different process or operator 40 tons per square inch. Another factor to be considered is that the strength of a weld made with electrodes of the same type will vary with the strength of the plate on which the weld is made. For the purposes in view, the company has considered the absolute strength of a joint of a particular form to be of no consequence, and has found the most convenient information to be the strength expressed as a percentage—described as the "joint efficiency"—of a single-V butt weld made on *similar material with the same welding rod by the same operator, the surfaces of the butt weld being machined down to the level of the plate.*

The object in making the tests was to determine not the overall strength, which, of course, could not exceed 100 per cent. of the plate strength, but the strength of the joint itself, which naturally may reach any figure. At first sight it might appear that the method adopted, which involves giving test efficiencies of some joints as higher than 100 per cent., is misleading, but since, when use is being made of the data, it is necessary to make an allowance for the vicissitude of a weld, the effect of which is always to reduce the rated efficiency to a figure not exceeding 100 per cent., the method adopted serves a highly useful purpose.

Although it is possible to produce a butt joint, the strength of which, when reinforced, is equal to or even slightly greater than that of the plate itself, there are so many uncertain elements in a welded joint that under no circumstance can a butt-welded joint be credited with more than half the plate strength, the reduced figure being referred to hereafter as the rated "strength." As the strength allowed for any other form of joint must be reduced in a similar manner, it is to be inferred that, though the welding of joints has not the inherent disadvantage of weakening the plate that the drilling of holes for rivets has, the full strength of the plate can only be utilised if the design of joints is improved. A high rating can never be given with any of the usual forms of joint, and the Report gives an indication of the trend that design must necessarily take for a high joint efficiency to be recognised.

A lap joint with a single fillet has, where there is no bending stress, a strength of only about 60 per cent. that of a butt-welded plate. Under ideal conditions, considerable increase of strength can be attained by a fillet being formed at both edges of the lap, but in practice it is difficult to ensure that both fillets will take their full share of the load and still more difficult to ensure that a maker will lay the plates with the necessary accurate fit.

It is commonly considered that a butt-welded joint is improved when a single or double cover strap is welded longitudinally over it, but there are strong objections to this construction as the straps hide the joint, preventing inspection of the sides. In general, with welded longitudinal cover straps, there is danger of a false sense of security. There is always the possibility that a crack may be initiated at a fillet, either as a result of bending stresses, unequal loading or some other cause, and that this may extend rapidly for the full length of the strap without any indication of the fault being given by leakage.

Several pages of the Report are devoted to a discussion of the use of short transverse cross straps, introduced by Monsieur Hoehn, of the Swiss Steam Users' Association. The device consists of butt-welded joints strengthened by short transverse cover straps placed at specified distances apart and welded to the plate all round their edges. The straps may be rectangular or have rounded ends, and the construction may be so strong that a greater load is required to tear the straps off the plate than to break them. It is considered that the design reduces the risk of explosion to a minimum, and has the advantage that with cross straps the concealment of joints ceases to be a serious matter.

The fillet weld is largely used for all sorts of purposes—numerically it is without doubt employed more widely than any other form—and the careful discussion of it, which occupies one section of the Report, will be studied with interest. The authors open with the statement that "a welded lap joint as usually constructed"—that is to say, with concave fillet at the lapping edges—"is exceedingly weak, and no attempt is made to bring the strength of the weld up to that of the plate." The strength of a weld metal in shear should only be taken as being 80 per cent. the strength in tension, hence the efficiency of joints of the ordinary forms can never exceed this figure, unless the breadth of the surface of contact in shear is made greater than the plate thickness. With a fillet weld, sufficiently full, 100 per cent. efficiency is obtainable when the breadth of the shear surface is 1¼ times the plate thickness. Hence a fillet should be convex for the strength to approach that of a butt weld. To meet present-day practice a suitable all-round basis on which lap welds can be rated is for the efficiency to be assumed as 60 per cent. as long as the throat thickness—that is, the diagonal thickness of the fillet—is not less than ·69 of the plate thickness. The reader must be referred to the Report itself for the full mathematical inquiry which leads to these conclusions, but the final results are conveniently shown in the chart reproduced below.

In this chart—

(1) The efficiencies compare the strength of joints in plates of thickness t with the strength of a plate of the same thickness when butt welded, but without reinforcement.

(2) The efficiencies refer to joints of the same width as the plate.

(3) With fillet welds the efficiencies apply when the fillets have an approximately straight contour, lying at 45 deg. with the surfaces of the plate. The efficiencies also apply to other contours as long as the throat thickness is not less than ·69 t.

(4) A joint may readily be made stronger than

FORM OF JOINT	η	REMARKS
NON-REINFORCED BUTT WELD.	100%	
LAP WELD WITH SINGLE FILLET. (SUBJECTED TO BENDING).	50%	UP TO ½ PLATE FOR CIRCULAR SEAMS. QUITE UNSUITED FOR LONGITUDINAL SEAMS OF PRESSURE VESSELS.
SINGLE BUTT STRAP. OF THE SAME THICKNESS AS THE PLATE.	50%	ditto. FOR MODIFICATION OF STRENGTH WITH SHAPE OF FILLET SEE SECTION IV FIGS X TO XIV.
LAP WELD (NO BENDING).	60%	
LAP WELD WITH TWO FILLETS (SUBJECTED TO BENDING)	100%	t NOT LESS THAN 2t. ONLY SUITABLE FOR LONGITUDINAL SEAMS OF PRESSURE VESSELS WHEN t DOES NOT EXCEED ⅝".
HALF-LAP JOINT WITH TWO FILLETS. (NO BENDING). OF THE SAME THICKNESS AS THE PLATE.	120%	
DOUBLE BUTT STRAPS. OF THE SAME THICKNESS AS THE PLATE.	120%	
JOGGLED LAP JOINT.	133⅓%	t NOT LESS THAN 2t. ONLY SUITABLE FOR LONGITUDINAL SEAMS OF PRESSURE VESSELS WHEN t DOES NOT EXCEED ⅝".
JOGGLED LAP JOINT.	133⅓%	ditto.
BUTT WELD WITH SINGLE STRAP OF HALF THE PLATE THICKNESS.	-	AN UNSATISFACTORY FORM OF JOINT. BENDING STRESSES ARE INTRODUCED & COMPLEX STRESSES SET UP AT THE FILLET WELDS, WITH THE RESULT THAT THE STRAP ONLY INCREASES THE STRENGTH OF THE JOINT APPRECIABLY ABOVE THAT OF A PLAIN BUTT WELD.

FORM OF JOINT	η	REMARKS
BUTT WELD WITH SINGLE STRAP OF FULL PLATE THICKNESS. OF THE SAME THICKNESS AS THE PLATE.	SAY 120%	AN UNSATISFACTORY FORM OF JOINT NOT RECOMMENDED FOR PRESSURE VESSELS.
BUTT WELD WITH DOUBLE STRAPS OF HALF THE PLATE THICKNESS.	160%	
SPECIAL FORM OF LAP JOINT. WELD METAL IN SHEAR.	80%	η STRENGTH IN SHEAR do IN TENSION OWING TO THE DIFFICULTY IN MAKING A WELD OF THE FORM SHOWN, THE EFFICIENCY SHOULD BE TAKEN NOT HIGHER THAN 70%
TRANSVERSE COVER STRAPS, WELDED AT THE SIDES ONLY. DOUBLE STRAPS OF HALF THE PLATE THICKNESS, OPPOSITE ONE ANOTHER. FRACTURE?	90%	THE STRENGTH DEPENDS ON THE FORM OF FILLET & IN GENERAL FRACTURE TAKES PLACE AT THE PLACE INDICATED BELOW. THE STRENGTH OF THE WELD PER UNIT LENGTH IS 75% THAT OF A LAP WELD AT THE END OF THE STRAP.
SINGLE STRAP OF FULL PLATE THICKNESS.	75%	
SINGLE STRAP OF HALF THE PLATE THICKNESS.	45%	THE RESULT IS RELATIVELY HIGHER THAN BEFORE, OWING TO THE STRAP RECEIVING GREATER SUPPORT AGAINST BENDING.
TRANSVERSE COVER STRAPS WELDED AT ALL SIDES. DOUBLE STRAPS OF HALF THE PLATE THICKNESS, OPPOSITE ONE ANOTHER.	150%	FOR INFORMATION ON BUTT JOINTS WITH COVER STRAPS SEE SECTION III, TABLE I & THE SUBSEQUENT LETTERPRESS.
SINGLE STRAP OF FULL PLATE THICKNESS.	125%	
WELDED FLANGES.	-	SEE SUBJECT MATTER RELATING TO FIGS XI TO XIV, SECTION IV.
BRANCHES & OTHER FITTINGS AFFIXED BY A FILLET WELD.	-	SEE SUBJECT MATTER RELATING TO FIG XVI, SECTION IV.

"THE ENGINEER"

STRENGTHS OF VARIOUS WELDED JOINTS

the body of the plate away from the joint. As the efficiency refers to the joint itself and not to the plate, it follows that a higher efficiency than 100 per cent. can readily be obtained. It has been possible to record efficiencies, where they exceed 100 per cent., by the adoption of specially designed test pieces.

(5) It must not be inferred that all the joints shown are permissible for pressure vessels. The figures given apply to a static tensile test, and it does not follow that the behaviour of joints subjected to the stresses of service will be in proportion to the efficiencies given.

(6) The strengths given apply only when the load is applied in the manner shown in the sketches. The efficiency is therefore in some instances superior with the joint applied to the circumferential seam of a pressure vessel, and sometimes inferior when it is applied to a longitudinal seam.

In a section devoted to the "Mechanical Pro-

perties of Welded Mild Steel," there are included two long tables exhibiting the actual results obtained in tests made by the company on specimens welded by different methods. These tables show the figures for tensile, Izod and Brinell tests on mild steel butt-welded plates. With regard to claims that are often made in favour of some particular electrode or other, on the ground of the high-tensile strength that it yields, the Report says :—

A high-tensile strength is certainly not a virtue in a pressure vessel made of boiler quality steel, and a low-tensile strength by no means indicates a defective weld. In a consideration of the strength of weld metal it is to be remembered that the strength of Swedish iron is rather under 20 tons per square inch, and possibly as low as 18½ tons per square inch with the steel annealed.

Within reason, therefore, a low-tensile strength in a weld is an indication of ductility, which is most desirable in a pressure vessel, especially when the stress allowed for the joint is low.

A carbonless weld with an undue tensile strength suggests the presence of a large amount of oxygen or nitrogen, involving an appreciable loss of ductility.

With an acetylene weld, though a rod that is virtually carbonless may have been used, the strength may be considerably over 20 tons per square inch. Though the raising of the strength is to a certain extent a result of carbonaceous metal from the edges of the plate having been fused into the weld metal, it is largely due to the flame having been adjusted so as to have a carburising action. Within limits the absorption of carbon is no detriment to a weld made with Swedish iron, for not only does carbon add in a measure to the tensile strength without appreciable loss in the ductility, but its presence is desirable if only as a guarantee that the weld has not been oxidised.

Now the strength of a butt weld is clearly limited to that of the plate. When there is good fusion it is more common than not to find the surface of the plate undercut by the arc at the sides of the weld. However strongly the weld may be reinforced, the strength at these positions cannot be increased. It is therefore quite clear that with a butt weld the edges of the reinforcement at the two surfaces of the plate should not be opposite one another ; for if they were the plate would be liable to be undercut at opposite points.

To afford an indication of the variation of the strength and the position of fracture with the reinforcement, a welder was asked to make a single-V butt weld on two strips of plate 3in. wide, and reinforce them according to his normal practice. A third strip he was asked to reinforce in whatever way he considered would give the strongest joint. The first strip was machined level at both surfaces ; the second was left unmachined, but it had no appreciable reinforcement at the bottom of the V ; and the third was not machined at either side. (The reinforcement consisted of local thickening.)

The non-reinforced strip broke through the centre of the weld, the position where the majority of the specimens tested broke.

With the weld metal strengthened by reinforcement, the weakest position may very readily lie at the side of the weld, as it did with the second specimen. As with a commercially made weld, this is always the part where the worst defect is to be expected, and even with a good weld the part that generally contains the greatest number of microscopic inclusions, it is important that it shall have ample strength.

With an increasing angle of bevel, the surface of fusion of a butt weld is increased and greater security obtained. If the strength of the surface of fusion is taken as being 70 per cent. that of the weld metal, the surface of fusion of a non-reinforced weld, for it to be as strong as the body of the weld metal, should be 1·43 times as deep as the thickness of the plate. This additional surface is to be obtained with a single or a double-V weld when the weld metal is made to subtend an angle of 90 deg., a figure deemed desirable for reinforced as well as for non-reinforced butt welds.

There is a natural tendency for a welder to cut down this angle unduly in order to save weld metal, and also for him to reduce the angle, as the thickness of the plate becomes greater. This latter course is inconsistent with a weld designed on the lines of the reasoning just given.

In connection with this question of the nature of the electrodes, we may turn to a later section of the Report in which Corrosion of Welds is discussed. The Report says :—

Wherever there is a possibility of corrosion being set up, to minimise the action it is a prime essential that the deposited metal should be as similar in composition as possible to the metal of the original plate. The liability of welds to differential attack is very noticeable when they are macro-etched. In addition, inclusions in welds act as nuclei for electrolytic attack. No matter by what process a weld has been made, if the resulting structure is not uniform and the welded part is liable to be subjected to a corrosive agent, a normalising treatment, apart from the other improvements it brings, tends to reduce corrosion.

Various classes of welds have been subjected to corrosive influences and their behaviour watched. These experiments are still in progress, and it is at present too early for any definite statement to be made on the relative merits. Of the specimens tested a good quality carbon arc weld behaved far the worst, the weld metal being very heavily eaten away. The weld metal, however, behaved considerably better when normalised than in the as-received condition. The feature that perhaps was most noticeable was the local attack that took place at the junction of the weld and the plate during the initial stages of attack. With all the welds tested and an acid corroding medium used, the existence of this local action was evidenced at the surface of the liquid, where fine gas bubbles could be clearly traced reproducing exactly the profile of the weld metal.

Local attack was most marked with bare wire welds or welds high in x-ide, while this attack was less marked with normalised specimens. At later stages of corrosion in acids, this local wastage in general was less marked at cross sections through the welds. With slag included at the junction, local corrosion was always very heavy, an action that heat treatment is, of course, powerless to reduce.

Acetylene welds that had been well fused to the original metal were free from local attack.

The interior of good oxy-acetylene or metallic-arc welds stood up very well to acid attack, and very often were eaten away considerably less than the plate, but in many instances where this occurred, the plate was of poor quality.

The question of Electrodes is further discussed in another section of the Report. From it we take the following passages :—

In view of the fact that in the present condition of general apathy on the subject there is a liability for welders to be attracted by cheapness, some form of check on the indiscriminate use of electrodes is required. The usual tests on the finished product are insufficient to afford guarantee that the performance will be satisfactory. It is quite illogical that, while control, both in the matter of quality and mechanical properties, is exercised in the manufacture of the plate and other parts used in a pressure vessel, precautions are not taken with weld metal, where control is equally or more desirable.

It is not proposed, however, to enter into a dissertation on the relative qualities of the various electrodes. This forms too large a subject, and would be out of place. Likewise a summary of all the qualities essential for satisfactory operation would form too long a list. It is proposed, therefore, to state only what are considered to be the most necessary properties for metallic electrodes used for welding pressure vessels :—

(1) The electrode should contain not more than ·03 per cent. of phosphorus, not more than ·05 per cent. of sulphur, and not less than ·50 per cent. of manganese. A higher percentage of manganese is strongly recommended.

(2) The rod should have a covering which has strong deoxidising properties, and which will react chemically with the mill scale and any rust on the plate being welded, and cause a slag to be formed, which will protect the surface of the weld from exposure to the atmosphere.

(3) The covering should have a melting temperature below that of the steel, preferably not more than 1000 deg. Cent., in order that the operating current may be kept low, reducing the expansion of the welded part and the liability for the metal to be overheated and allowing the molten slag to separate readily from the weld metal.

(4) The slag should have a coefficient of contraction greater than that of the metal, so that it may be removed easily.

(5) The electrode should be protected against rusting in a damp atmosphere, either by the covering or some other suitable means.

(6) The covering should be capable of withstanding temperature changes and the usual rigours of service that are to be expected during manipulation, without cracking.

(7) The electrode should deposit weld metal free from porosity and high in ductility.

The following additional properties are deemed necessary to meet special conditions of service :—

(8) When an electrode is used in a position where it has to be bent, the covering should be sufficiently plastic for a portion of the electrode, 9in. long, to be bent to a right angle without the covering showing any sign of flaking off, the test being made after the electrode has been dipped in water and re-dried.

(9) When the electrode is for use on fire-boxes of boilers, the quality of the deposited metal should be such that strips cut from welded plates can, while at a red heat, be bent and flattened, without showing defect.

(10) When welds are hammered hot while metal is being deposited, or when the welded article is subsequently forged or subjected to deformation when hot, the quality of the weld metal should be such that strips of welded plate can, when at a red heat, be forged down to half their original area, without showing defect.

In the last section of the Report there are outlined Provisional Rules for Fusion-welded Non-fired Pressure Vessels, which will no doubt attract the attention and the criticism of welders. They are too extensive to quote here, but we welcome them as a serious attempt to do something towards putting the welding of pressure vessels on a sound basis. We agree with the concluding sentence of the Report : "Regulations are required if the legitimate development of welding is not to be retarded, and until such regulations are framed and enforced, it is inevitable that trouble and disappointment will be the lot of makers and purchasers alike." We venture to express the hope that general agreement may be found with regard to rules —not necessarily those now put forward—between all the registration and insurance companies.

Iron and Steel Institute.

No. I.

THE autumn meeting of the Iron and Steel Institute was held at Newcastle-on-Tyne this week, under the presidency of Professor Henry Louis, M.A. It opened on Tuesday morning, September 10th, in the Festival Hall at the Exhibition, when the Lord Mayor, Councillor A. W. Lambert, extended to the members a hearty welcome. He recalled that fifty-two years had elapsed since a conference of the Institute had been held at Newcastle, and expressed the hope that such a long period would not be allowed to pass before the conference was again held there. The Institute could not have chosen a more appropriate venue for its 1929 conference. The Exhibition embraced within its scope not only Newcastle, but the great industries of the whole of the North-East Coast, which included, of course, the great steel and iron industries of Tees-side, the county of Durham and Tyneside. The Institute had also chosen well in coming to Newcastle to do honour to its President, Professor Louis, and Newcastle was grateful to it for the great honour the members had bestowed upon him. He was a citizen possessing one of the most agile and expert brains in the world of science at the present time.

The President, returning thanks to the Lord Mayor and Corporation for the hearty welcome extended to the visitors, said that although fifty-two years had elapsed since the Institute had last held a conference in Newcastle, its members felt that they were on friendly and familiar ground when they came to the North-East Coast. He recalled that in May of this year the Institute had celebrated the sixtieth anniversary of its first meeting, and that on the present occasion it was entitled to celebrate the sixtieth anniversary of its first provincial meeting, which, appropriately enough, was held on the North-East Coast, and at the invitation of the iron trade of the district. Furthermore, the North-East Coast was the birthplace of the Institute, because its formation was due to the famous ironmaster, Sir Lothian Bell, who had held the offices of the Lord Mayor of Newcastle and the President of the Institute at the same time, and was proud of the fact that he held those offices, because they indicated the confidence placed in him both by his fellow citizens and his fellow technologists. The Institute deeply regretted the absence of Sir Hugh Bell, a distinguished son of a distinguished father, who had written to express his own regret in being unable to attend.

With regard to the structure of the industries of the North-East Coast, the President said he looked upon it as being based on a tripod, the three legs of which were represented by coal mining, iron manufacture and engineering. Obviously, if any one of these three legs were to go the entire structure of the industries of the North-East Coast would collapse. He saw no danger of that happening, however, and certainly there were no signs of it in the industry in which the members of the Institute were specially interested. The history of the iron trade in that part of the world went back at least seventeen centuries ; throughout the whole of that period it had been developing continuously, and it had by no means reached its apogee ; it was still advancing and improving.

The reading of papers was then proceeded with.

The first paper read was entitled "Notes on the Damping-down and Re-starting of Blast-furnaces," and was presented by C. S. Gill.

DAMPING DOWN AND RESTARTING BLAST-FURNACES.

The frequency with which during recent years it has been necessary to shut down the furnaces, and await the settlement of the numerous trade disputes, has brought the whole question of the damping down and restarting of blast-furnaces very much to the front, and it is in the hope of encouraging a frank interchange of ideas on this important subject that this paper has been written.

To many furnacemen, the period immediately following the renewal of operations, after a prolonged stand, is a time of stress and trial, in which hard and high tap holes, together with other troubles—such as iron over the slag fall, and slag back in the tuyeres—play prominent parts, and if means can be found to eliminate these unpleasant features it will be to the advantage of all.

Each blast-furnace manager has his own system which he follows when it becomes necessary to interrupt temporarily the working of his furnaces, one which has been developed to suit the local conditions of the particular plant ; but besides this on every such occasion the exact method to be adopted is dependent upon many factors, of which the three mentioned below are some of the most important.

(a) *Probable Duration of the Stand.*—If the stand is to be of short duration there is no great difficulty in estimating the suitable coke blank, and, by the exercise of ordinary care, in seeing that this is quite definitely in the hearth before the blast comes off ; and it is then possible to obtain perfectly satisfactory results on restarting. In the present paper, however, the author has in view more particularly that damping down which is necessary when the expectation is that the furnace will stand for an indefinite or prolonged period.

(*b*) *Condition of the Linings.*—Where the linings are known to be seriously damaged or worn, it becomes a matter of discretion as to whether they are in such a condition as to warrant the blowing out of the furnace, raking out the material, and doing any repairs to the brickwork which might be necessary. In that case the furnace would be blown in again in the same way as starting a new furnace. This is outside the scope of the present notes, but it is certain that, given reasonable care, it is possible to damp down and re-start practically any blast-furnace in such a way as to do a minimum of damage to the furnace, and to have it on to full output within a week of commencing the task of blowing in, whilst at the same time escaping most of the trials usually associated with the process.

(*c*) *Whether All or Only a Proportion of the Furnaces are to be Damped.*—If only a proportion of the furnaces is to be damped down, it is possible to obtain exceptionally satisfactory results by adding a comparatively small blank of coke—with the usual precautions—and by keeping the downcomer valves open, to obtain a pressure of gas from the other furnaces during the stand. This quickly eliminates all combustion, and allows the furnaces to cool down in a condition which permits of the blowing in being accomplished with practically no difficulty at all. Details are given later of a case in which this was done, and the furnace stood damped for eleven months.

The author then outlines the general principles and methods adopted at Consett whenever a prolonged shut-down is necessary. No particular novelty is claimed for them, except that they have eliminated trouble from this usually troublesome undertaking.

Mr. George Ritchie, after complimenting Mr. Gill upon his very practical contribution to the subject of blast-furnace management, said that in his own experience with a large blast-furnace plant he had found that generally it was more economical to blow out than to damp down when a stand of any duration had to be faced. However carefully one might damp down, he had found that blowing-in troubles were much more severe and costly than when re-starting a furnace. One had to take into account, of course, the condition of the lining. Undoubtedly there were cases where the linings were in such a condition that they would probably fall in when the furnaces were blown out; but, in his opinion, furnacemen had been unduly apprehensive on that point in the past, and much damping down had been resorted to in cases where it would have been far cheaper to blow out and re-start.

Mr. Guy Barrett thought the author had summarised very neatly what should be done when damping down and when blowing in, and if one could do just what he advised, there should be no trouble. On the other hand, he felt bound to say that he was rather in sympathy with Mr. Ritchie's views. As the result of his experience of the stopping and starting of furnaces in a hurry, he had come to the conclusion that it really did not pay to damp down a furnace if one had the time to blow it out. But he would not blow it out in the ordinary way; he would blow it low and rake it out. When a furnace was damped, one did not like to knock it about at all; the less one applied sledges and bars to a damped furnace the more one was likely to keep it air-tight. It was a very large structure, and it was shaken if one tackled any brickwork repairs, so that there was air infiltration which it was very difficult to check. Mr. Gill had suggested leaving the furnace open to the gas main to keep up the gas pressure at the top. That was certainly a very good method, but there was one point which must be watched in a special case; if one were using the dry cooling plant, and the gas fired on the top of the furnace, and the pressure fell in the gas main, as it might do, very hot gas would pass into the "bags," which was a source of very grave danger.

Sir Frederick Mills said that that was perhaps the most pathetic paper the Institute had ever listened to, though he congratulated Mr. Gill upon having set out in so admirable a form what must be done when it was necessary to damp down and re-start. It was not long ago since he had told an American that he thought we in this country had become the world's experts in damping down and starting up blast-furnaces, but he would beseech all concerned to try to arrange matters so that we could run our blast-furnaces continuously until they were absolutely unfit to run another day.

The President, referring to his own experience, said it was more than half a century ago since he had had to damp down and re-start a blast-furnace, and he supposed he had had to meet special difficulties, because there was only one furnace, which meant that when he wanted to start up again the blast was dead cold, and a good many days had been occupied in heating up the stove sufficiently to give the hot blast. The great terror at that time was the danger of getting gas back in the ring main of the furnace, resulting in explosions when the furnace was started up; he had known of a ring main being blown to pieces by an explosion of that kind, and of one or two blast-furnacemen who had devised special safety valves to prevent it. Mr. Gill had not mentioned that risk, but he presumed that modern blast-furnaces had been so improved that it was a perfectly easy matter to overcome the difficulty.

Mr. Gill, replying to the discussion, said he had advanced practically no theories, and that the paper was simply a record of the results of many years' experimenting in damping down. That experience had led to such a condition that the trouble of blowing in, to which Mr. Ritchie had referred, had become practically negligible. There were strong arguments, and sometimes conclusive arguments, in favour of blowing out and re-starting, but if one could blow a furnace in after damping practically without any trouble, and could get the furnace working perfectly normally on the second day, most of the arguments in favour of blowing out—though not all—fell to the ground. However, in the paper he had not been dealing with blowing out; he had concerned to been describe the methods which he had adopted with some measure of success where damping down was adopted.

Before the next paper was taken the President announced the receipt of an invitation from Mr. Engineer Sykora, the President of the Czecho-Slovakian Society of Engineers, endorsed by Monsieur Eugene Schneider, of Creusot, France, to the Institute to hold its autumn meeting in Prague in 1930. Monsieur Schneider also extended a hearty welcome to the various works he controlled in Czecho-Slovakia. The Council of the Institute had agreed to accept the invitation, and, bar accidents, the members might regard Czecho-Slovakia as the venue of the autumn meeting next year.

Mr. A. T. Adam then presented some notes on wire for mining ropes.

WIRE FOR MINING ROPES.

The conditions to which the wires in mining ropes are subjected in service are briefly summarised, and the effects of wear, bending, and direct kinetic stresses on the wire are discussed. The effects of corrosion are not considered. A discussion on the significance of endurance and fatigue tests on cold-worked steel follows, and an argument is submitted in support of the view that since rope wires are inevitably stressed beyond the limiting safe range for repeated stresses, their capacity for withstanding overloads and deformation for a sufficiently lengthy period is more important than their fatigue limit as determined by lengthy endurance tests on a basis of several million cycles of stress. It is also argued that the internally stressed condition of cold-worked metals, by ensuring a wider distribution of stress, increases the state of what Professor Haigh calls "primary hysteresis," and is therefore a safeguard against stress concentration due either to discontinuities in the metal itself or to the general service conditions. General tests on wire point to a stage in drawing, varying from 50 to 80 per cent. reduction of area, according to the various factors influencing drawing, which represents the point of greatest efficiency. The need for a simple test by which this point may be readily determined for any material is mentioned. The conclusion is drawn that the lowest carbon steels capable of giving the tensile strength desired in the finished wire without over-drawing are to be preferred for mining rope wire, and, finally, it is claimed that the conclusions are entirely supported by practical experience.

Mr. E. A. Atkin, after complimenting Mr. Adam upon his paper, said that in defining what should be done in regard to the production of good roping wire we should start with the steel itself. Recently he had visited some American works, and, though he would not say that the Americans were more advanced than we were in this country, he had noticed that they were paying particular attention to the making of the steel used, and the wire used for roping and other purposes. We also could not pay too much attention to that if we were to produce really good wire ropes. Referring to a table given in the paper, showing the results of tensile tests on wires, he asked how the author defined the yield point, which was given as 65·4 tons per square inch for the wire as drawn and 52 tons per square inch for the heat-treated wire. If tests on wire were carried out very carefully, he said, there was really no yield point. Emphasising the importance of obtaining wire which was stress-free, he said that sheet metal, if passed through rollers several times, became more pliable, so that it did not crinkle; similarly, if wire were passed backwards and forwards through rollers it could be relieved of its internal stresses, so that the number of torsions and twists would go up and its bending properties would be improved. The properties of fine-gauge wire could be improved by drawing it through the fingers three or four times.

With regard to lead cooling, he said that Messrs. Rylands Bros. had proved that by means of it one could produce better wire than by the ordinary air cooling, if the lead cooling were carried out with something like precision. Figures given in the paper, showing the effect of drawing on the mechanical properties at various stages in the reduction of 0·30 per cent. carbon steel wire patented, in No. 2 S.W.G., 0·276in. diameter, indicated that in the case of the wire cooled in lead at 350 deg. Cent. the torsions and the bends had increased as compared with the same material when air cooled; in other words, the wire had become, not perhaps more ductile, but a better quality wire, and would stand an endurance test better than the air-cooled wire. With regard to Mr. Adam's reference to regular and irregular torsions, he emphasised the importance of getting regular torsions, and also of ensuring that the torsions should not be localised, so that the wire should not twist up at certain points along its length when being twisted. He and his colleagues agreed with Mr. Adam's remarks with regard to large grain. It used to be thought that if the tempering were carried out in such a way that large grain growth could be induced in the sorbitic condition, the resulting wire had a much longer fibre and gave better results in practice. A point to which the users of steel generally did not pay as much attention as they ought was the importance of making the best possible use of the carbon in the steel. There was a tendency to continue to increase the carbon content, instead of giving the low-carbon steel the proper heat treatment so that it would give the very best results. Mr. Adam had pointed out that by using a low-carbon steel, and lead cooling, one could obtain better results than with a high-carbon steel and air cooling. With regard to over-drawing, he said there had always been disputes as to what was meant. One of his colleagues was inclined to the view that by feel, by snarl, and by examination of the fracture of the wire very good results could be obtained.

Indicating a line of research which Mr. Adam might with advantage follow up, he described a machine by means of which he had carried out a kind of fatigue test on wires. The wire was first bent into a loop, the two ends were fastened into the machine, and rotated in reverse directions. By obtaining a loop of a definite radius, holding the ends of the wire tightly in the machine and rotating rapidly, one could obtain some definite function of the quality of the wire. The reduction of the number of rotations the wire would stand if the radius of the loop were reduced was surprising; if the radius of the loop were reduced to 2in. or 3in. the wire would perhaps break after twenty revolutions, whereas if the radius were about 1ft. it would stand over 200 revolutions.

Dr. Stephen L. Roberton expressed agreement with the author that at the present time the problems connected with rope wire might best be approached by a careful consideration of existing facts. The Wire Ropes Committee of the Safety in Mines Research Board had spent a considerable period in collecting data from the examination of recapping samples and failed ropes, and the diversity of the effects observed in such material gave support to the belief that the time had not yet come when the life and usefulness of wire ropes in practice could satisfactorily be treated under any comprehensive theory. Thus, as Mr. Adam had pointed out, it was of little value investigating the fatigue limit for hard-drawn rope wire when it was known definitely that ropes in use were subjected to stresses which were much in excess of the safe range. It was probable that valuable results might accrue from a consideration of the shape of the endurance curve above the safe fatigue range. The superiority of soft wire over hard, when considering the effects of wear, he suggested, was not so evident as Mr. Adam had indicated. In a colliery winding rope, soft wires that were worn to knife edges, were just as dangerous as harder wires which might be cracked or split. He had observed cases where a work-hardened layer on the surface of a wire had given rise to transverse cracking, but longitudinal cracking, which he presumed the author meant by the term "splitting," was much more rare, except where it occurred in conjunction with transverse cracking. It might be true that a soft wire would wear without the incidence of cracking, but certainly it would wear more rapidly than a hard wire, under the same conditions, and thus the net result would be that ropes composed of hard or soft wires might give approximately the same life. A further consideration was that a rope composed of soft wire would need to be of greater diameter than a rope of the same strength but composed of hard wire, and that introduced financial considerations with respect to the winding machinery. Commenting upon the author's tables and graphs of mechanical properties in conjunction with the reduction by drawing, he said that the phenomenon of over-drawing had long been recognised, but up to the present no satisfactory explanation had been forthcoming, and, indeed, the incidence of over-drawing in the production of wire could not readily be detected. The author's graphs showed well-marked discontinuities at definite points, dependent upon the carbon treatment of the rod, and although at the point represented by the break in the curves the wire could hardly be called overdrawn, yet obviously it represented a critical stage in the production of wire. With the establishment of such a fact, and the acceptance of Mr. Adam's suggestion that no wire should be drawn to a greater degree than that represented by the discontinuity, it would be of value to ascertain if that critical point could be raised to a higher tensile strength by a variation of factors such as the speed of drawing and the rate of reduction. Referring to Mr. Atkin's remarks with regard to inclusions and the quality of the steel used for wire, he said he had inspected a large number of wires taken from ropes in use, and had been appalled by the number of inclusions which were sometimes found in a piece of wire $^1/_{10}$in. in diameter and 1in. long.

Dr. W. H. Hatfield, referring to the author's statement that, as Swedish steel only was used, no doubt as to the quality of the steel could arise, ventured to suggest that the author had no intention of casting reflections on British steel manufacture, but had simply intended to pay a compliment to our Swedish friends. (Laughter.) Surely, however, a technical paper of that kind should not be placed before a major Institution without giving adequate particulars concerning the origin and nature of the steel. Was it made by the open hearth, the Bessemer, or the electric process? We all knew that the Swedes could make as bad steel as we could. (Laughter.) He asked for some information as to the process by which the steel was made, and its composition. It was not scientific—using the word in its best sense—to base a lot of experimental evidence on a material of which the author had given particulars of only one constituent, *i.e.*, the carbon content. Continuing, he challenged those who stated that wire ropes under service mentioned were subjected to stresses in excess of the elastic range of the material, and he called for proof of the statement, because wire ropes should not knowingly be subjected to stresses of that magnitude. On a number of occasions he had examined failures,

and had found that in most instances failure was due to the method of construction of the rope.

Mr. J. S. Glen Primrose said that whilst in general soft wire wore longer in a rope than hard wire, and was less liable to develop cracks such as occurred in the latter when a thin martensitic layer had been formed by friction, the fact remains that, to attain the high tensile values often demanded—values of 130 tons were asked for when something about 100 tons would be ample—it was safer to use a higher rather than a lower carbon content if the risk of over-drawing was to be avoided. Many people who had had to determine whether the cold-working in wire drawing had brought the metal into the undesirable condition known as "over-drawn," had re-discovered the almost universally applicable test advocated by the late Dr. McWilliam, namely, a short immersion of the wire in boiling water. If the wire were definitely over-drawn, the torsions dropped very remarkably, even if, as often happened, the wire, as drawn, gave a satisfactory number of twists. When that test was inconclusive, another useful medium of investigation was the micro-structure, which gave a measure of the original grain size and the degree of deformation which had produced the fibre lengths, to which there was a limit in satisfactory wire. He asked if Mr. Adam had found that better working properties could be obtained in a rope from wire which was completely sorbitic, *i.e.*, without any free ferrite or laminated pearlite, and that this desideratum could be achieved with a lower carbon content when lead patenting was adopted instead of the more commonly used air cooling of the wire as it came from the furnace. Fatigue tests of individual wires by either the Wöhler or Haigh methods did not always give values which were of use in computing the life of a rope stranded from such wires, but it would appear that the more frequent use of the endurance machine mentioned in the appendix to the paper would lead to a discovery of values which would be of use in guiding the mining engineer in selecting ropes to meet his particular requirements. (The machine mentioned gave each rope tested a reciprocating motion round three pulleys, 12in. in diameter, measured from the bottom of the groove. The pulleys were placed so as to give the rope reverse bends. The length of travel was 4ft., and the rope passed twice round the pulleys for each revolution of the machine. A constant tension of 1500 lb. was maintained on the ropes during test.)

Mr. J. D. Brunton suggested that if steel makers would crop their billets a little better and get rid of the inclusions, rope makers would be able to make better wire ropes.

Mr. A. Hultgren agreed with Dr. Hatfield that the origin of a steel was not alone a sufficient guarantee of high quality.

Colonel Blackett, speaking as a mining engineer, said that he and his colleagues wanted to be able to secure a sound rope without knowing very much about it. They had been endeavouring to set up certain standards in this country, and he hoped those standards would protect them. A handbook, containing a great deal of helpful information, had been issued a little while ago by the Mines Department. It contained also a notable paragraph to the effect that the quality of wire rope depended not only upon the maker of the wire rope, but also upon the steel maker himself, and that the users of wire ropes could not be sure of getting sound ropes unless they could ensure that the process at every stage of manufacture was right. It seemed to him that the whole secret lay there.

Mr. F. L. Booth, as a user of wire ropes for winding coal, appealed to the members of the Institute to continue their investigations, so that they would be able to produce a reliable specification for winding ropes. The usual method of testing a winding rope at a colliery was simply to look for broken wires on the surface. Recently, however, examinations had been made of pieces of rope taken off at the time of re-capping, and he had been perturbed to find that the broken wires on the outside had given no indication of what was happening inside. There were far more broken wires inside the rope than outside in almost every case. Opinions among manufacturers varied. One maker had said that it was necessary to use very high-grade high-tensile steel wire, whereas another had said that one should use softer wire, of low tensile strength, and naturally a larger rope. Both were manufacturers of repute.

Mr. Adam, replying to the discussion, said that one could not emphasise too strongly the importance of the quality of the steel used for wire rope manufacture. Replying to Dr. Hatfield, he admitted that perhaps the reference in the paper to the use of Swedish steel was unfortunately worded, and if he could have given the source of the steel used it would have been sufficient, but it was an undoubted fact that when a wire manufacturer in this country set out to make the highest grade of wire he had to use Swedish steel. He did not imply that British steel makers could not make steel of that high quality; he was perfectly certain they could, if they would take the trouble. He had repeatedly asked them if they could make steel for that purpose, and he had been told that they could, but that it was not worth their while to do so.

Replying to Mr. Atkin's reference to the yield point, he agreed that the yield point of drawn wire was, of course, indefinite, but in some cases one did get an indication of a yield point, or perhaps more correctly of a proof load. That was what he had really meant by his reference to the yield point. He agreed with Mr. Atkin as to the value of the tests applied by practical men. A man who was handling wire continually could tell probably a great deal more about a wire by feeling and snarling than one could tell by laboratory tests. With regard to the bending test suggested by Mr. Atkin, he said he had always felt that the proper bending machine for wire would be one which would allow the wire to take its own natural bend, rather than to force it round pulleys.

Replying to Dr. Robertson's remark that soft wire might be just as harmful as hard wire, Mr. Adam said he had not referred in the paper to very soft wire; there was a happy mean. His remarks were intended to emphasise that hard wire was not necessarily the best wire for resisting wear; although soft wire wore to a knife edge, one could see the damage more readily. It did not necessarily follow that if one used a steel with too low a carbon content, and produced too soft a wire, it would be necessary to increase the size of the rope. In his view, there was too great a tendency to aim at high tensile and breaking loads, and to base the factor of safety on the breaking load. It was quite possible that the factor of safety might be based on something else when one went into the question more deeply. For a very high tensile wire, up to 130 tons, for instance, as mentioned by Mr. Primrose, one would need to use a very high carbon steel. The paper did not state, of course, that one must use a low carbon steel, but a steel with the lowest carbon content consistent with the tensile strength of the wire. It was very doubtful if such tensile strengths as 130 tons were really desirable in running ropes.

The meeting was then adjourned until Wednesday morning.

(To be continued.)

South African Engineering Notes.

Twelve American Engines for S.A.R.

THE Norwegian locomotive carrier "Beldis" arrived at Cape Town on July 22nd from Philadelphia with twelve complete locomotives consigned to the Minister of Railways and Harbours. The "Beldis" is specially designed for the transport of heavy weights, such as locomotives, machinery, guns, tugboats, and small craft for deep sea and river work. The vessel carried on this occasion six complete engines on deck and six below. She had also two 60-ton boilers on deck and two below in the hold. Each of these boilers is 60ft. in length and occupied the width of the steamer. Four of the engines weighed 90 tons each and the remaining eight 80 tons each. There were, in addition, the tenders. The heaviest weight landed at once was little short of 100 tons. The heavy derrick which the "Beldis" carries has a normal lifting capacity of 105 tons, but the gear is sufficiently powerful to lift 125 tons with safety, although such heavy weights give the ship a list. The locomotives carried were eight of the "Pacific" type—known locally as "Big Berthas"—and four "Mountain" type locomotives, known as "Big Bills," and all were made by Baldwins Locomotive Works, Philadelphia. In South Africa there are twenty locomotives of the "Pacific" type and seventy-eight of the "Mountain" type. One of the "Pacific" type created a record some time back for the run of 956 miles from Cape Town to Johannesburg. This was the first time that complete locomotives of such great weight had been landed at Cape Town. They were ready to steam away when placed on the rails as soon as coal and water were taken in and steam got up.

Road-making Plant.

Quantities of mechanical road-making plant, including tractor, ripper and grader, &c., are being purchased by municipalities in the Union. These machines are nearly, if not quite, all of foreign makes, and the plants supplied by the Caterpillar Company, California, the Fordson people, and other American makers are much in favour. Germany has also entered the field and achieved considerable success, as also has Belgium. In the last few weeks two municipalities on the Witwatersrand have ordered 22 H.P. equipments of tractor, road grader and scarifier, all in one unit. They are made by the Munktell Works, Sweden, which has supplied other municipalities out here. The Johnannesburg City Council is now about to ask for tenders for another mechanical road-making plant, including tractor, ripper and grader.

Electric Current at Crown Mines.

At the July meeting of the South African Institute of Electrical Engineers, held in the house of the Scientific and Technical Club, Johannesburg, Mr. Elsdon Dew, M. Inst. C.E., M.I.E.E., F. Am. I.E.E., read an article on "The 20,000-Volt Underground Transmission System at the Crown Mines," which had been prepared by himself and Mr. H. Deneby, M.I.E.E., A. Am. I.E.E. Mr. Elsdon Dew said that the paper was the history of an innovation in electrical power transmission underground, of which South Africa could claim to be the pioneer. It was a novelty in vertical transmission, and it established the fact that South Africa did not lag behind in electrical progress and development. When the arrangement of the electric power supply was originally worked out for the various distribution services of the mines the voltages adopted—2000 and 500 volts—were a distinct advance on the voltages previously in use in local mining work. These voltages had given entire satisfaction and excellent service; but, with the advance of mining on the Witwatersrand, and the greater depths at which it was being carried on, with the use of electrical power for all purposes, and the greater distances involved, the question of the use of higher voltages had had continual attention. But it had only been recently possible seriously to recommend the application of the definitely higher pressure of 20,000 volts, because the advance in the art of the manufacture of cables of that voltage for vertical shafts had not until lately been proved, either from the point of view of utility or economy. Mr. Elsdon Dew went on to describe in technical detail the manufacture of the cables as contracted for by the Crown Mines undertaking, and the rigidity and severity of the tests to which they had been submitted for their capacity to withstand electrical and mechanical strains. The main contractor was the Metropolitan-Vickers Electrical Export Company, Ltd.

Rhodesian Copper Merger.

It is understood that a big financing arrangement is receiving the consideration of the various mining groups controlling the Northern Rhodesian Copper Mines. Several millions of capital is being raised by British and American groups for the further development and equipment of the mines. Recent exposures of ore by development and drilling thoroughly warrant a big step forward. It is now considered not unlikely that the Roan Antelope Mine, with its extensions, will eventually be found to contain anything from two hundred million to four hundred million tons of ore. N'Kana is also certain to yield a total running in the same direction, and already the presence of not less than 40,000,000 tons has been proved and indicated there. Latest exposures at Mufulira are astonishingly good, and the results at N'Changa and in the Rhodesian Congo Border Concession are extremely satisfactory.

SIXTY YEARS AGO.

IT should not be imagined that the congestion of traffic in the streets of London or the insufficiency of the bridges across the Thames within the Metropolitan area presents anything of a new problem. In his day Pepys was caught in a traffic jam in the streets of London, and from then onwards there does not appear ever to have been a time when the roads and bridges of the Metropolis were adequate to the traffic which they were called upon to carry. Sixty years ago the congestion on London Bridge was the cause of much delay and complaint. The bridge, constructed to Rennie's designs, was opened in August, 1831, and replaced the old bridge lined with shops and houses, which stood a little lower down the river. Rennie's structure had a carriageway 35ft. wide and two 9ft. footways. By 1869 it was insufficient for its purpose. Since its erection the population of London had doubled, and the demands made on it had increased threefold. It was estimated that in addition to the vehicular traffic using the bridge, half a million passengers crossed it daily. For some time previously suggestions had been made for its enlargement, but the proposals advanced seem to have carried little weight until Mr. H. Fulton, the engineer to the Bridge House Estates Committee, drew up a detailed plan for the widening of the structure. Mr. Fulton proposed to devote the whole of the original width of the bridge to the carriageway and to provide new footways, each 12ft. wide, on wrought iron cantilevers springing from either face of the structure. By this means the capacity of the bridge would have been nearly doubled at an estimated cost of from £20,000 to £30,000. In our issue of September 10th, 1869, we mentioned Mr. Fulton's scheme and praised it. We noted, however, that opposition to it had already been expressed in the daily Press on the ground that if it were carried out the bridge would be disfigured. We joined issue in particular with a correspondent of *The Times*, who had some derogatory remarks to make about the unsightly works of contemporary engineers and the "iron-monger style of architecture" which they commonly adopted. We have seen in our own day a similar battle waged over Rennie's other structure, Waterloo Bridge. The fight in that case is even yet not decided. It may therefore be chronicled that although Mr. Fulton's scheme was not carried out, a somewhat similar one was given effect to by Sir Benjamin Baker in the years 1902–05, whereby the width of the bridge was increased by 11ft. The bridge, as it now stands, still retains unimpaired the handsome appearance of the original structure.

BRITISH CHEMICAL STANDARD FOR BRONZE.

WE are informed by British Chemical Standards, 3, Wilson-street, Middlesbrough, that the third of a series of non-ferrous standard analysed samples is now ready for issue.

The analysis is as follows:—

	Per cent.
Copper	85·5–
Tin	9·96
Zinc	1·86
Lead	1·83
Phosphorus	0·25
Antimony	0·24
Iron	0·07
Nickel	0·04
Arsenic	0·06

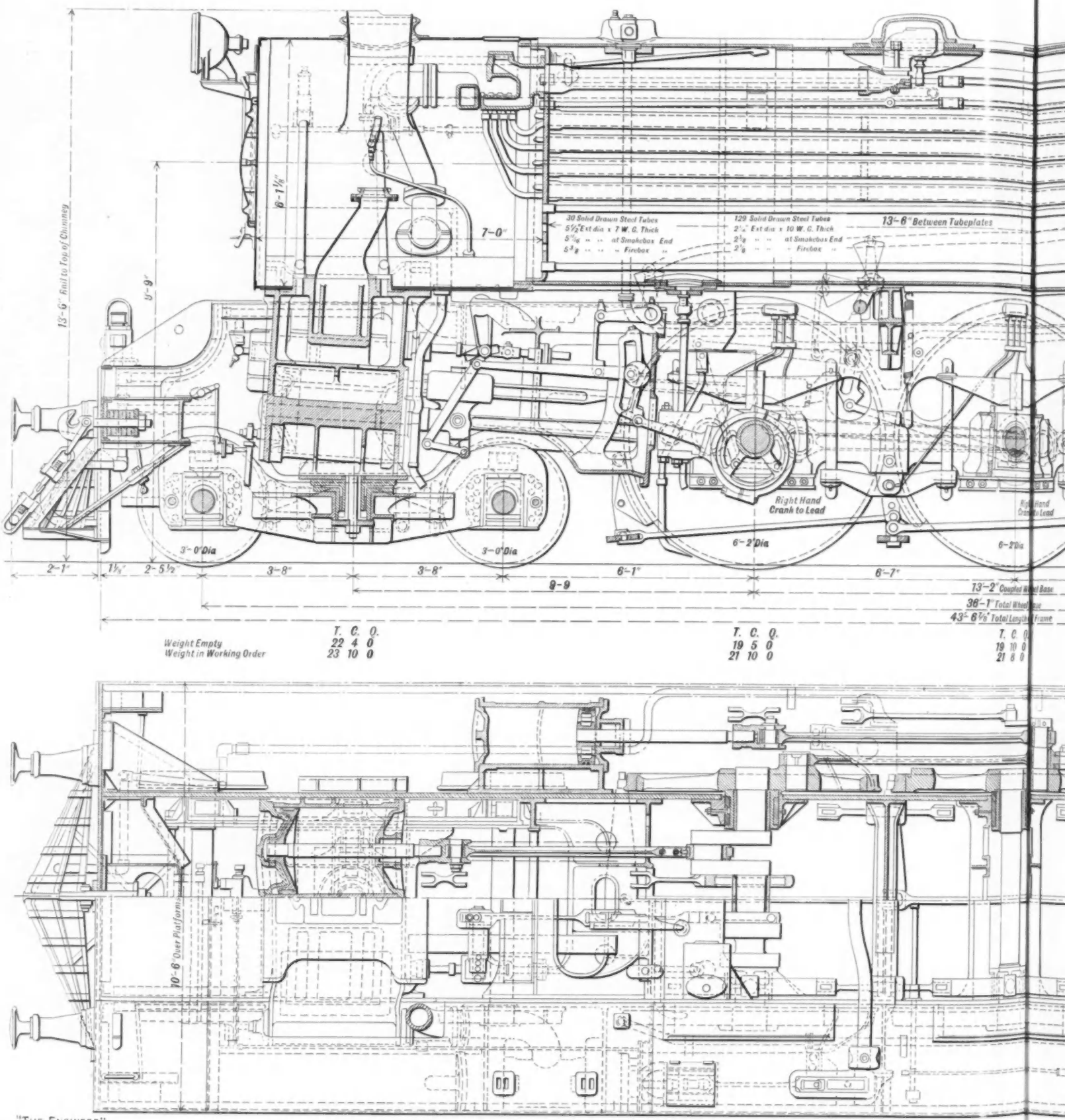
This standard has been prepared in order to meet the need of a gun-metal and a phosphor bronze, the two being combined in one standard. It will enable chemists to check their methods of analysis and to settle disputes between buyers and sellers. The composition does not correspond to any particular specification, but the sample contains all the elements usually met with in the ordinary gun-metals and bronzes.

The analyses have been made by ten chemists experienced in testing this class of alloy. Reference chemists, Government departments, manufacturers and users are represented.

The standard is available to anyone at a price based on ultimately covering the cost of preparing and issuing it. The three usual sizes, 50 grm., 100 grm., and 500 grm. bottles are provided, and a certificate giving the names of analysts collaborating, together with their analysis and notes on the methods used, is furnished with each sample.

BENGAL NAGPUR RAILWAY—FOUR-CYLINDE

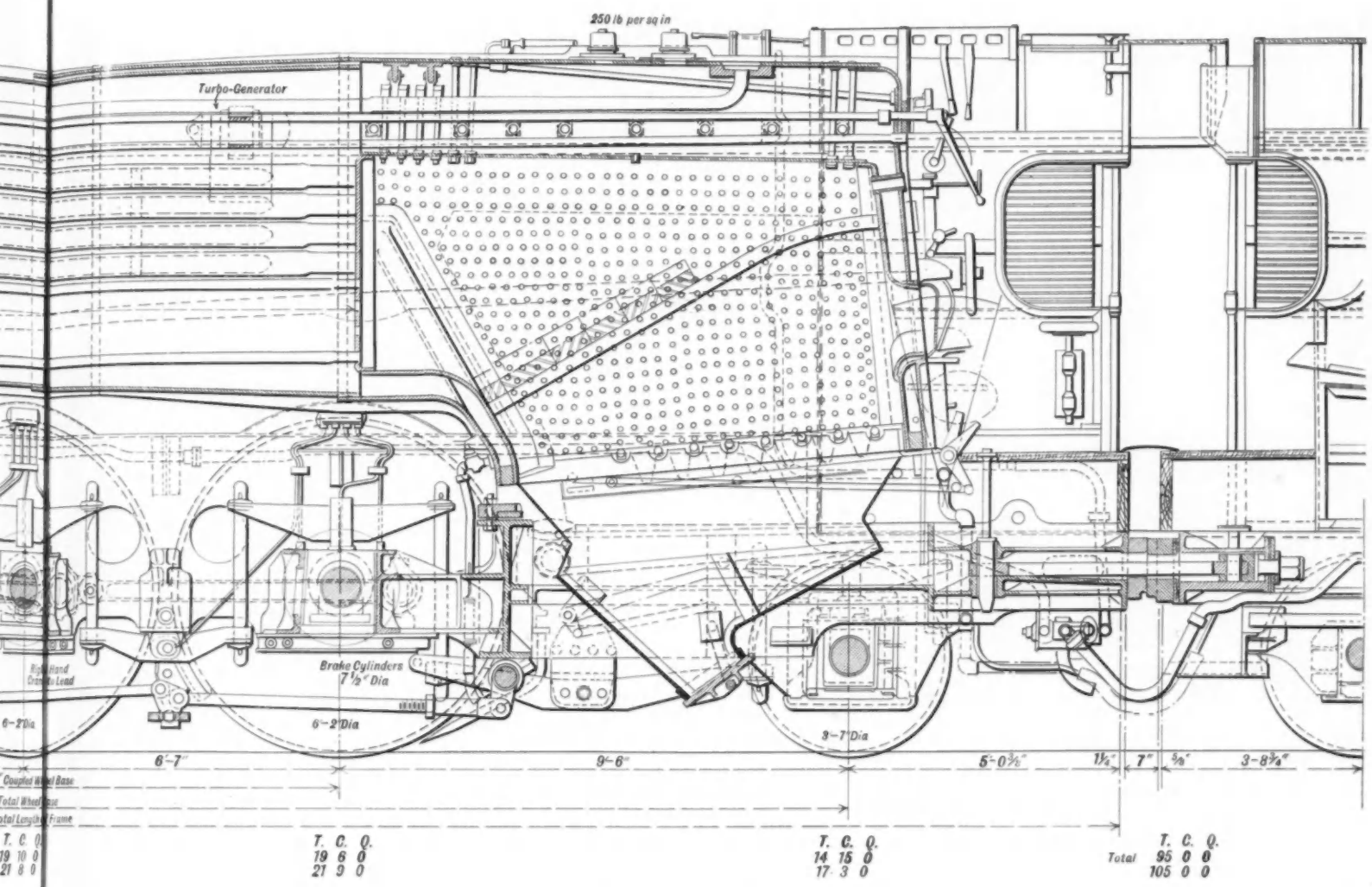
NORTH BRITISH LOCOMOTIVE COMPANY,

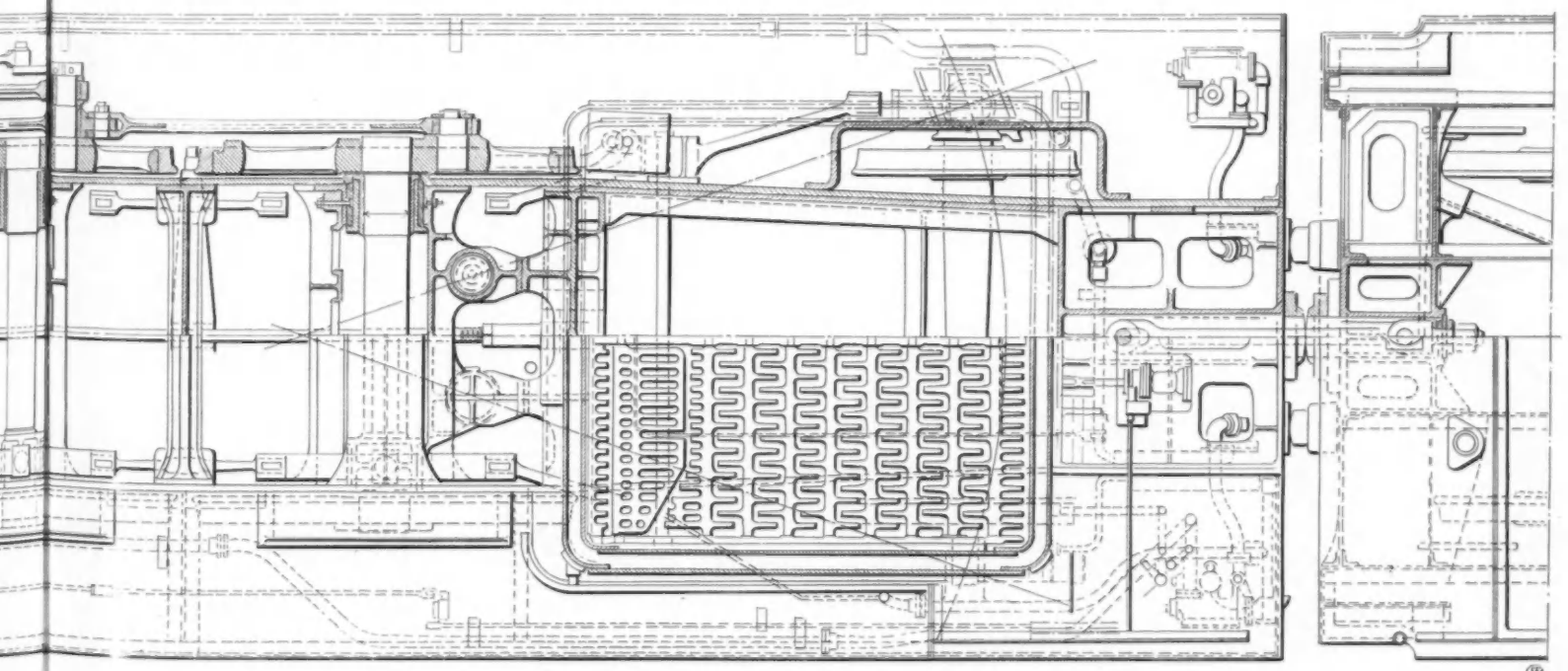


UNIV. OF MICH.

LINDER COMPOUND EXPRESS LOCOMOTIVE

E COMPANY, LTD., GLASGOW, ENGINEERS





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Railway and Road Matters.

THE directors of the Great Western Railway have authorised improvements to be made in the lines and sidings on the Brecon and Merthyr, Rhymney, and the Pontypridd, Caerphilly and Newport sections, in order to admit of the running of larger engines over those routes.

THE London, Midland and Scottish Company announces that steel sleepers are being laid down at two selected places on the main line between Euston and Carlisle. We judge from a large number lying on the bank between Bletchley and Wolverton that that is one of the selected lengths.

THE Great Western Railway not only allows a rebate of 5 per cent. in the carriage charges where coal is conveyed in 20-ton wagons, but when the reduction of the payment for tipping and weighing coal is reduced, on October 2nd, from 7½d. to 6d. per ton, that charge will be 5d. per ton where 20-ton wagons are used.

THE traffic returns of the companies show that, at the end of the thirty-fifth week, the London and North-Eastern has secured an increase over the corresponding period of last year of £680,000, and the Great Western one of £362,000. On the other hand, the Southern shows a fall of £178,000 and the London, Midland and Scottish one of £523,000.

THE subject of the "How It Works" article in the *Railway Newsletter* for August was that of picking up the mails. Therein is related the interesting fact that the West Coast "Postal," presumably when between Stafford and Crewe, drops into the ground exchanging net mail matter for the Irish mail, which the latter train, following fifteen minutes later, picks up by its own exchange net.

THE Corris Railway was sanctioned by 27 and 28 Vic. c. 225 to convert a 2ft. 3in. gauge tramway into a railway and to build a line from Corris to Dolgelly. It was opened in 1883, and runs from Ratgoed Quarry as a mineral line to Aberllefini, and thence as a passenger line to Machynlleth. Being a narrow-gauge line it was excluded from absorption under the Railways Act, 1921, but is now to be acquired by the Great Western, whose Cambrian section it joins.

To supplement the note as to Volk's Railway in our Seven Days' Journal of September 6th, it may be remarked that an electrically-propelled vehicle designed by Robert Davidson was tried on the Edinburgh and Glasgow Railway in November, 1842. It was 16ft. long and 7ft. wide, and was propelled by eight powerful electro-magnets. Including batteries, magnets, &c., the whole apparatus weighed a little over 5 tons. Later it was tried on other Scottish railways, but was finally wrecked, when lying in a shed at Perth, by some jealous railwaymen.

THE Salford Corporation is making an interesting experiment in its road light signals at the crossing of Great Cheetham-street over Bury New-road. Motorists have had to rely upon the first in a queue of cars giving a hand-signal to those behind as to the condition of the signal. That has not always been done, and there have been many minor collisions. The new experiment is twofold. First, the signal has been duplicated by having a second lamp on the other, or right, side of the road. Further, a warning board, lettered "Traffic Signal Ahead," has been erected about 100 yards in the rear of the signal to warn the drivers of road vehicles that they are approaching a light signal.

THE fact that the London, Midland and Scottish Company has ordered thirty 40-ton side-discharging wagons for the conveyance of coal in bulk from collieries on its system to the electric power station at Stonebridge Park, is claimed by our enterprising contemporary, the *Daily Express*, as indicating that the companies have taken its advice as to larger wagons, but we would point out that many years ago the Lancashire and Yorkshire introduced bogie mineral wagons for its locomotive coal traffic, an example that was subsequently followed by most of the other leading companies. It is, of course, also a different thing to supply coal to a power station to handling it for a coal merchant. Moreover, the railway company uses these new wagons only for those collieries where the loading screens are suitable.

THE New Zealand correspondent of the *South African Railways and Harbours Magazine* reports that Mr. H. H. Sterling, the general manager of the New Zealand Railways, has entered a strong protest against the attitude taken up in that country as to accidents on level crossings. In view of the frequent criticism in the same direction in this country, it is of interest to note that Mr. Sterling said that "We get innumerable suggestions as to what should be done. People say we should put in crossbars and bridges, and put men on to guard the crossings, but on investigation we find that over a large part of the Continent of Europe crossing keepers are being cut out, and the onus is left entirely on the motorist to carry. I want to say—and it is not generally known to the public—that the Department has no control over the question of vision at crossings where it affects private property, but the Department does its best to make level crossings fool-proof.

IT is reported that 716 passengers were injured in train accidents last year. Excepting the 765 of 1926, that is the highest total under that heading in Table III. of the annual report since the 915 average of the ten-year period 1875–1884. No explanation is offered of this big increase over the yearly average for 1917–26 of 498, but we notice that 159, 59 and 51 were injured in the Darlington, Ancoats-Curve and Glasgow accidents. As showing how the number of injured persons may grow, we may recall that after the Gale-street collision of November 24th, 1926, complaints were received at the time from 70 passengers, but a further 334 sent in their names subsequently. But the most remarkable accident in that respect was that which occurred outside Birr, on the Great Southern and Western of Ireland on July 19th, 1910. Seventy-six passengers reported injury there, but when the report by the late Colonel von Donop was published, the number was given as 492; later the annual returns gave the figure as 509. As both the trains concerned had twelve carriages between them it looks as though every passenger lodged a complaint.

Notes and Memoranda.

IT is claimed that a fractionating tower recently set to work in America is the largest of its kind in the world. It is 18ft. 6in. in internal diameter by 80ft. high inside. The tower is used in the oil refining industry, and has a capacity of 6250 barrels of oil a day.

IT has been stated by the Tin Industrial Applications Committee that it had been found that by mixing a small amount of tin with lead and adding a smaller quantity of another non-ferrous metal the strength of the lead was increased enormously as was its resistance to corrosion and cracking.

THE Deepwater power station of the American Electric Power Company is to be operated at a steam pressure of 1200 lb. per square inch. The turbines will exhaust at a pressure of 190 lb. per square inch, and this steam will be utilised for the boiling of water to provide steam for process work in an adjoining works.

THE South Australian Harbours Board has recently put to work what is claimed to be the largest pile-driving equipment of British make. This machine is capable of handling reinforced concrete piles of 24in. square section, 70ft. long, and weighing up to 15 tons. It is worked by means of steam, and has a striking blow of 5 tons.

WE are informed by the Secretary of the Department of Scientific and Industrial Research that under the Order in Council dated February 6th, 1928, the Lord President of the Council has appointed the Right Hon. Lord Rayleigh, Sc.D., F.R.S., Sir Arthur Balfour, K.B.E., Sir William H. Bragg, K.B.E., D.Sc., F.R.S., and Sir James Walker, D.Sc., Ph.D., LL.D., F.R.S., to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. The following members of the Advisory Council have retired on completion of their terms of office:—Sir H. C. Harold Carpenter, F.R.S., Dr. G. C. Clayton, C.B.E., Sir Richard T. Glazebrook, K.C.B., F.R.S., and Sir James H. Jeans, D.Sc., LL.D., Sec. R.S.

IN the official report on the failure of a return tube boiler on board a small steamer, the furnaces are described as being made with flanged conical or Gourlay necks for attachment to the combustion chambers. A crack developed in the neck of one of the furnaces, and the contents of the boiler were blown out. It is stated that the design of the neck of the furnaces is more commonly used with furnaces of the corrugated type than with those of the plain type, and this construction with a plain furnace tended to localise the expansion stresses of the furnace at the neck. The repeated stresses acting throughout the long life of the boiler ultimately set up fatigue of the material at the place of failure and a crack formed. The boiler was about thirty years old.

A MESSAGE from Havana says that Monsieur Georges Claude, the famous scientist, in an interview at Matanzas on the results of his experiments with the immersion of a tube, 1800 m. long, for the utilisation of the thermal energy of the sea, said that on the whole he was satisfied with the important data that had been acquired for future use, in spite of the loss of part of the tube in the Bay of Matanzas, when it was being towed from the river Canimar where the different sections of the tube had been put together. This mishap was due to the extremely bad weather, the season being too advanced, but it was impossible to postpone the immersion of the tube. All arrangements had been made for fresh experiments next March, which would be made under much better conditions, the previous trial having shown what should be avoided.

SLOW drying and wrinkling of paint are two troublesome characteristics often encountered in paint jobs carried out during cold and damp seasons, according to the *Dutch Boy Quarterly*, published by the National Lead Company. To wait for clear dry weather is the only certain remedy, but in case the painting must be done in damp weather, care should be taken to use a pure linseed oil reasonably free from "foots"; one of the principal causes of slow drying is the use of an inferior grade of linseed oil. Danger from wrinkling can be minimised by seeing that the finishing coat is well brushed out. Linseed oil will thicken in cold weather, and it is this thickening which is the indirect cause of wrinkling. The immediate cause, however, is that the paint is applied too thick. Turpentine in the finishing coat will often thin the paint sufficiently so that it can be brushed out in a thin film. Although the use of turpentine removes some of the gloss from the finishing coat, the addition of small quantities not exceeding one quart to the standard finishing coat formula will not seriously affect it.

A LITTLE homily in the design of vertical boilers is given in a recent official report on an accident which happened to the donkey boiler of a small steamer. The boiler failed, according to the report, on account of the fact that sufficient allowance had not been made for the upward expansion of the fire-box when at its working temperature. Undue mechanical stresses were thereby imposed locally on the lower shell plate, which became corroded and reduced in thickness until it could not withstand the pressure to which it was subjected. In boilers of types similar to this it is frequently the practice to carry the downward load, caused by the steam pressure on top of the fire-box, &c., by means of a specially thick base ring, by which the fire-box is connected to the shell. In the present case, however, it appears to have been the intention of the designer to carry most of this load on two plate stays suspended from the crown of the shell. These were of substantial construction, each being 11¼in. by ⅝in. connected to the shell and fire-box crowns by double angles 3½in. by 3½in. by ½in. Under a cold hydraulic test everything would appear to be in order, but with the boiler under working conditions and the temperature of the fire-box plates much higher than that of the outer shell, things would be different. The fire-box having become longer and being unable to expand upwards on account of the rigidity of the staying system of the furnace crown would exert a downward thrust, which would pass along the cone-shaped plates of the furnace sides and tend to push outward the bottom of the shell plate, at the same time throwing considerable stress on the base of the fire-box.

Miscellanea.

IT is reported that a new seam of good anthracite coal has been struck at Cefn Coed, Crynant, Neath, where sinking operations have been going on for some time past.

IT is proposed to augment the supply of potable water at Nagpur, India, by pumping from the river Kanhan. The scheme will involve a pipe line of some 12 miles, and the expenditure of about 28 lakhs of rupees.

THE latest report from Canada concerning the Welland Canal is that the lock at the Port Colbourne–Lake Erie end of the new canal will be ready for operation in the near future. This lock is 1380ft. long, with a depth of 30ft. of water. It will be operated in connection with the old canal.

IT is reported that the contractors for the construction of the new dam in the Silent Valley for the supply of potable water to Belfast have succeeded in finding bed-rock throughout the whole site, and that construction is to be started immediately. The work, which is being carried out by Messrs. Pearson, will involve an expenditure of about £2,000,000.

A THIRD platinum reduction plant, to operate on Merensky Reef, will, according to the *South African Mining and Engineering Journal*, shortly be under construction on the farm Swartklip, No. 988, 60 miles north-north-east of Rustenburg, beyond the Pilandsberg. This plant, which is to have a capacity of 250 tons a day, will probably be completed early in the New Year.

THE Gorgas Memorial Laboratory at Panama has just started work. It is concerned with the work of subduing tropical diseases, is a memorial to the man who largely helped in the completion of the Panama Canal, and is subsidised by the American Government. The work carried out in this establishment should appeal to all engineers working in tropical conditions.

IN order to prevent the pollution of Lake Michigan with the phenol wastes of the by-product oven plants of Chicago, three factories have been impelled to put down tanks large enough to store five days' production of waste, so that, in the event of the flow of the Chicago River being reversed by heavy rains, the waste can be held back until the river again flows from the lake to the drainage canal.

ACCORDING to Dr. J. S. Haldane, one of the chief factors in the acclimatisation of miners to high underground temperatures is that the person working regularly in a hot atmosphere "learns" to sweat. An acclimatised miner can exude as much as 6 lb. of sweat per hour, when a person unused to the atmospheric conditions may manage only ½ lb., and even find his skin utterly dry, with resulting rise in body temperature.

WITH a view to inspire farmers with enthusiasm for greater utilisation of electricity, the Overhead Lines Association proposes to compile as full details as are obtainable of the number of kelvins consumed on farms in 1928 and the various uses to which electricity was applied by them. Each supplier of electricity is being invited to answer as fully as convenient a questionnaire concerning the farms which he now supplies with electricity.

LOW-GRADE clays, shales, and shale rock when heated rapidly at about 2000 deg. Fah. for a short period of time expand to 2½ to 3 times their original volume. Material sintered in this fashion when subsequently crushed and used as concrete aggregate yields, according to *Engineers and Engineering*, concrete of the same or somewhat larger compressive strength and of only two-thirds the weight of concrete made with the ordinary rock and sand aggregate. The decrease in deadweight resulting from the use of these materials effects a considerable saving in the cost of structural steel for large buildings, bridges, &c.

THE first Diesel engine propelled cargo ship to be built in Canada was launched from the yard of the Davie Shipbuilding and Repairing Company, at Quebec, on August 22nd. She is named the "Grainmotor," and is being constructed for the Canada Steamship Lines, Ltd., for the grain-carrying trade between Port Colbourne and Montreal. Her dimensions are 252ft. long, beam 42ft., depth 20ft. 6in., with a grain-carrying capacity of 100,000 bushels. She is to be propelled by Bessemer oil engines, of 800 horse-power, driving direct. There are to be three auxiliary oil engine driven generator sets of 75 H.P. output to provide power for lubricating oil pumps, winches, windlass, and the steering gear. A donkey boiler will provide steam for heating.

THE new bridge over the Delaware River at Tacouy consists of a three-span continuous truss of the half-through type, 743ft. long, a tied bowstring arch 550ft. long, a bascule span of the rolling lift type affording a clear opening of 250ft., and another three-span continuous truss 748ft. long. The bridge has a roadway 38ft. wide of concrete, except on the bascule span, which has a timber deck paved with asphalt planking. The arch has a clearance of 64ft., which will give passage for the sand and gravel tows and will accommodate nearly all the vessels now navigating the upper Delaware. The bascule will be available for passing any taller vessel. The bascule span functions as a three-hinged arch when closed, and in appearance closely resembles the spans of the continuous trusses.

ACCORDING to the official returns of Lloyds' Register of Shipping, the total number of ships of over 100 gross tons belonging to Great Britain and Ireland which were lost owing to casualty or stress of weather in the quarter ended March 31st, 1929, was 21 steamers and motor ships, aggregating 28,957 tons. The return for the same class of vessels for all other countries included 82 ships of 138,322 gross tons, added to which there were 18 sailing vessels of 8072 gross tons total. Other losses by breaking up, &c. amounted to 18 steamers and motor ships belonging to Great Britain and Ireland totalling 48,034 gross tons. For all other countries the figures were 47 ships of 125,525 gross tons total, and six sailing ships of 6617 gross tons total. The gross reduction in the mercantile fleet of the world over the period reviewed was from all causes 168 steamers and motor vessels, aggregating 340,881 gross tons, and 24 sailing ships aggregating 14,689 gross tons, making a total of 192 ships of all kinds, representing 355,570 gross tons.

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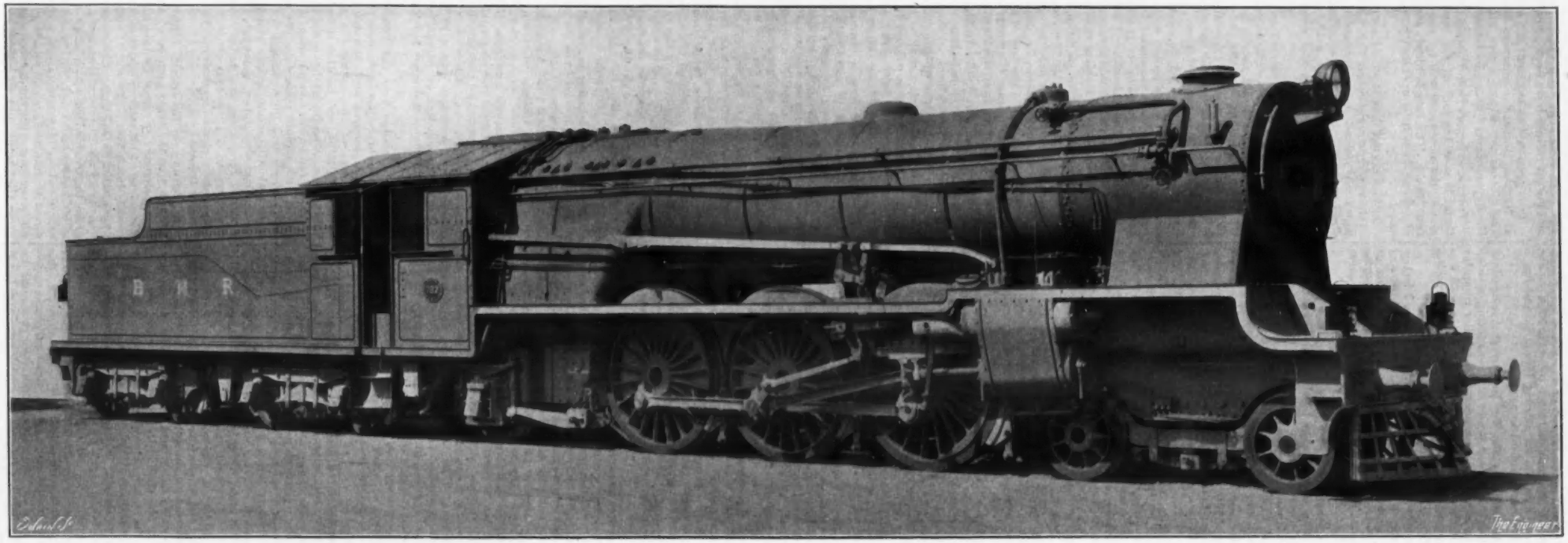
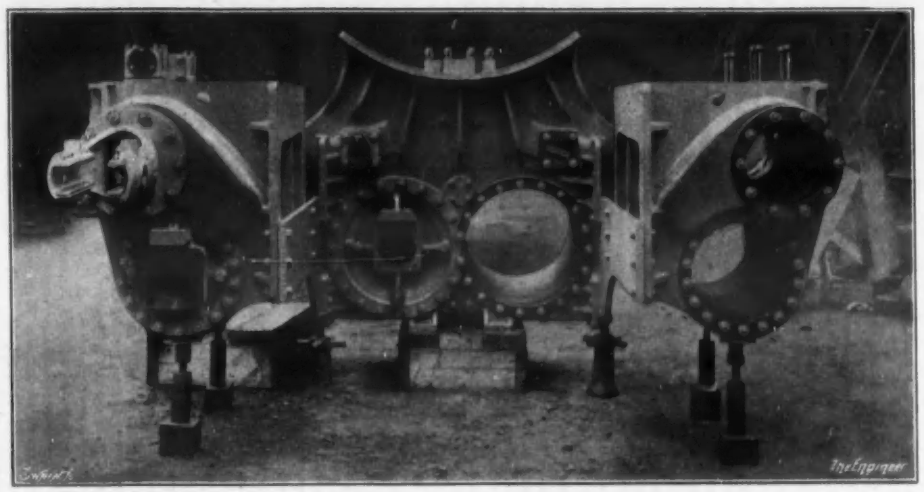
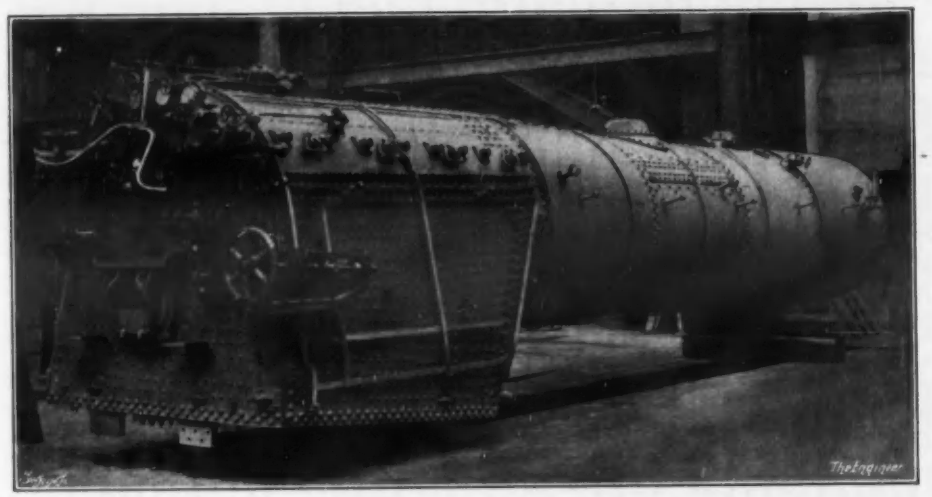
(*For description see page* 284)







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THE ENGINEER.

SEPTEMBER 13, 1929.

The Schneider Trophy Victory.

IT cannot be denied that from several points of view the race for the Schneider Seaplane Trophy, held last Saturday over the Solent, was disappointing. Of the ten machines entered—three each from Great Britain, France, and Italy, and one from the United States—only six, the three British and the three Italian, were brought forward for the contest. The British machines finally chosen to compete for the Trophy were the product of one firm—the Supermarine Company—although two others produced by the Gloster Company were available. Of the British machines, two, fitted with Rolls-Royce engines, were of this year's design and construction. The third, fitted with a Napier engine, was one of the machines produced for the 1927 contest at Venice. The Italian entries can be similarly described. All were Macchi machines, two of them with Isotta-Fraschini engines being new, and one, with a Fiat engine, being a machine of 1927. The race, in effect, therefore, represented on the material side a contest between two aircraft firms and four firms building aero-engines. The result can be speedily told. The two new Italian machines were forced by minor mishaps to abandon the contest after one lap of the 216-mile course had been completed. The Italian machine of 1927 completed the seven laps at an average speed of 284 miles an hour, thereby just surpassing its British contemporary, which, with a speed of 282 miles an hour, reproduced almost exactly its performance at Venice two years ago. Neither of these machines, however, had at any time a chance of gaining the Trophy, for the two new British machines showed themselves capable of a greatly improved speed. On one of them Flying-Officer Waghorn secured the Trophy for this country with an average speed of 328·6 miles an hour. On the other Flying-Officer Atcherley completed the seven laps at an average speed of 325·5 miles an hour. Although the pilot of this second machine was disqualified by the judges for failing to round one of the marks correctly, he has to his credit the fact that on two of his laps he established the record speed of 332 miles an hour. As a demonstration of Italian sportsmanship and pluck, nothing was wanting. But as an international speed contest, the race at no time provided satisfaction.

The public assembled on the shores of the Solent last Saturday afternoon was undoubtedly disappointed that force of circumstances and ill-luck prevented the contest from being other than what it was, virtually a present of the Trophy to this country. It was, too, if we mistake not, disappointed in that the race failed to provide that ocular impression of speed which it was led to believe would be one of its chief sensations. The machines took off from Calshot at intervals of twenty minutes, and as a consequence only once, and then but for a very brief period, were there as many as three machines in the air simultaneously. The contest was spread over a total time of about two and a half hours, and, except on one occasion, when Dal Molin on his first lap was overtaken and passed by Waghorn on his fifth, the machines in flight were never in anything approaching ordinary racing formation. The public had to rely on the information concerning the individual lap times broadcast to it from Ryde Pier, in order to follow the progress of the race. It was quite useless to attempt to form an estimate of the speed of the machines with the unaided eye. Even experts were misled. Speeds of 300 miles an hour and over are far beyond the limit which our unaided senses can be trusted to estimate. It was commonly remarked that without the assurance of the time-keeper's figures it would have been difficult to believe that the machines were flying at exceptional speeds. The noise and roar with which their passage overhead was accompanied was the principal impression left on the senses of the spectators. Only in so far as such noise was a reflection of the power of the engines and in so far as engine power is associated by past experience with speed, was there any direct or indirect sensory impression of high velocity. To many, as to us, it must have seemed that the speed boats which raced over the waters of the Solent before and after the contest were at least as fast as the contesting seaplanes. This absence of any real sense of speed was coupled with a feeling of wonderful safety. The public was duly informed as to the risks which the pilots were taking in flying as low as fifty feet above the water and in turning the corners of the course at the utmost limit of acuteness in order to save precious fractions of a second. It knew that all the pilots were flying with a margin of a tenth of a second between them and death, but we doubt if the sucking of a single orange was stopped on that account. The steadiness of the flying and the completeness of the control which the pilots appeared to have over their machines practically robbed the contest of all sensation. Doubtlessly, too, the public, if it thought at all on the subject, felt that the apparent ease and safety with which the two Italian pilots Cadringher and Monti alighted on the water soon after they had completed their first laps, only increased the justification for regarding the race as an event devoid of any real excitement. Whatever impression to the contrary may have been gathered from the daily Press, we can from our own personal experience vouch for the fact that the public stayed away from the shores of the Solent in large numbers. Those who, fearing that the crowds would be unbearably dense resolved to remain at home and listen to the broadcast commentary on the race, probably received a far more intense impression of the contest than did those who actually saw it. We have nothing but praise for the excellent manner in which the official commentators performed their difficult task. Never once was there the slightest hint of exaggeration in their remarks. Their listeners at home had, however, their imaginations excusably keyed to a high note, and undoubtedly they saw in their mind's eyes more than the spectators on the shores of the Solent actually witnessed.

As an international speed contest for seaplanes, the contest, by force of circumstances, was, like that of 1927, a disappointment. As a public spectacle it was far less impressive than, say, the Royal Air Force's annual display at Hendon. What, then, remains to be said in its favour ? Undoubtedly, a very great deal. Intrinsically, the aeronautical industry of this country has gained by the two successive victories of 1927 and 1929 an addition to its already high prestige throughout the world. British machines, engines, acces-

sories and materials will stand at a higher level of appreciation in the world's aeronautical markets than they have ever done before as a result of last Saturday's events. Our record in the contest is unsurpassed, however we look at it. Of the ten races which have now been held for the Trophy, we have won four. From a speed of 86·8 miles an hour, which was sufficient to secure us the prize in 1914, we have carried it through 145·7 in 1922 and 281·6 in 1927 to 328·6 this year. No other country can show such an advance. Italy's first victory in 1921 was secured at 107 miles an hour. Its third, and most recent, in 1926 was obtained at a speed of 246·5. The United States carried off the prize for the first time in 1923 with a speed of 177·4 miles an hour and for the second time in 1925 with a speed of 232·6 miles. France has no victory to its credit after the first contest in 1913, when her winning speed was 45·7 miles an hour. Behind this record thus presented there lies a tale of sustained and concentrated technical endeavour on the part of the British aeronautical industry and of all connected with it on the production and scientific sides which can be read by the world at large. The design and construction of our winning machines and their engines are preserved secret, and will not be fully disclosed for some considerable time yet. The value of the work done on their production is, however, of far more importance to the industry at large than the actual details of their design. The spur to technical progress which the building of a Schneider Cup racer provides is felt throughout many branches of the engineering and metallurgical industries, and leaves a lasting effect. That effect, we feel assured, reacts not only to the advantage of the whole of our aeronautical industry, but to the benefit of many important branches of engineering having little or no direct connection with aeronautics.

Power Rectifiers.

Now that metal-cased mercury vapour rectifiers are being made in this country, there is no reason why they should not be freely discussed. When they were only built abroad, anything said in their favour was apt to be taken as an inclination to boost foreign goods and to underrate the merits of British-made converters. But a desire to adhere to old ideas will not stop the march of progress or influence customers anxious to take advantage of new developments. While our large electrical firms have been somewhat slow in interesting themselves in power rectifiers, it has long been evident that sooner or later they would have to do so or lose business. So much has recently been done abroad that the rectifier can no longer be neglected in this country. The greatest progress has been made on the Continent, where the rectifier was first developed, but interest in this class of apparatus is increasing in America. A table published in a recent issue of the *Electrical World* shows that since 1927 the total capacity of rectifiers installed or ordered has amounted to 48,975 kilowatts. Possibly, that may represent but a small proportion of all the converting plant put into service or ordered during that period; the total capacity of rotary converters and motor generators installed was possibly much greater. But in any case, it is significant that America now has a certain amount of this relatively new plant in operation, and apparently in successful operation. Judging from the favourable reports of American engineers who are employing rectifiers, there would seem to be every prospect of a big increase in their use in the near future. Several papers on them have recently appeared in the *Journal* of the American Institute of Electrical Engineers, all written by operating engineers, and while minor troubles have been experienced, the general conclusion is that the modern rectifier is satisfactory.

Perhaps the most enthusiastic American advocate of the rectifiers is Mr. George E. Wood, supervisor of power stations to the Connecticut Company, who believes that in a few years' time developments will be made in their design that will give them first choice in all installations where the conversion of alternating current to direct current is concerned. With that opinion, however, we can scarcely agree. Every case must be considered individually. The rectifier obviously precludes all possibility of regeneration; it cannot help to improve the power factor of the alternating current system, and it is water-cooled. Even the originators of the power rectifier realise that it cannot meet all requirements, although when it is merely a question of converting alternating current into direct current under ordinary conditions it is likely to become a keen competitor of the rotary converter. It is perhaps a pity that the power rectifier has come to this country at a time when to a large extent the use of direct current is dying out. But if ever main line electrification is undertaken, the English firm that is preparing to produce power rectifiers may be well repaid for its trouble. For 3000-volt lines, rectifiers would seem to be particularly advantageous, mainly on account of their high efficiency as compared with the motor generators needed for that pressure. American experience shows, as well as that on the Continent, that telephone troubles can be eliminated by a filter system tuned to resonance at the pronounced frequencies developed by rectifier equipment. While it has been found that, in general, a traction system energised with rectifiers without means of limiting the harmonic components has a greater inductive influence on neighbouring communication circuits than lines energised by rotating machines, by means of properly designed filtering apparatus the inductive influence of rectifiers may be reduced to a level comparable with that of rotating equipment giving a good wave shape. Of course, these filter circuits cost money. The total initial cost of American rectifier sub-stations exceeds that of rotary sub-stations, but it is expected that when the demand for rectifiers increases, the cost will diminish. Against this increased initial outlay, the American users of rectifiers set a better all-day efficiency and lower maintenance cost, including that of maintaining the auxiliaries. Emphasis is also laid on the fact that the rectifiers deal with short circuits without fuss or disturbance. But the enthusiasm of some of these American engineers sometimes makes them a little unconvincing. "When it is remembered," states one writer, "that there are no intermediate starting or running A.C. contactors, no brush-raising devices, no checking of polarity and synchronising requirements, no massive moving parts and oiled bearings, and no carbon and copper dust to be scattered throughout the station, there should be no surprise at the claim and eventual proof of considerably lower cost for inspection, cleaning and maintenance of rectifier equipment."

The absence of heavy moving parts is, as everyone knows, one of the advantages of the rectifier. The fact that it does not require synchronising is another advantage, but surely the writer is aware that all rotaries are not tap started. Surely he knows that there is another method which avoids brush-lifting gear and polarity correction. In this country rotary converters work remarkably well, and possibly they cost less to maintain than those in America. Nevertheless, American operating experiences are of interest. Hitherto, English engineers have had to rely mainly on the reports of rectifier manufacturers, which can scarcely expected to be anything but favourable. Users of new plant, however, are not likely to say they are satisfied with it, if it gives trouble or works at low efficiency or is costly to maintain, unless they are anxious to conceal the fact that in choosing the new plant they have made a grave error. In view of these favourable reports from America it is satisfactory to learn that at least one British electrical firm has begun to produce power rectifiers. Apart altogether from the relative merits of rectifiers and converters, it is desirable that our electrical firms should be in a position to offer both types of plant. Static apparatus appeals strongly to many engineers, and for that reason alone it is essential that electrical manufacturers should familiarise themselves with rectifier construction. For the higher voltages rectifiers may easily eclipse all other converting equipment, and incidentally help the cause of railway electrification. While there is no such thing as a 3000-volt, 50-cycle rotary converter, apparently there is no difficulty in building rectifiers for that pressure, or even higher pressures, if required.

The Indus Flood and Engineering Science.

IT is reported that the Superintending Engineer at Sukkur, Mr. A. A. Musto, C.I.E., has reason to suspect that the recent great flood caused by bursting of the natural dam which had formed on the river Shyok has scoured out the bed of the Indus, the future flood levels of which will, accordingly, be reduced. It is to be hoped that if this be the case—and there is a strong presumption that a flood so great would have that effect—the chief engineers concerned will seriously tackle the work of ascertaining the nature and extent of the scouring. This could best be done by forming a committee of civil engineers and meteorologists to collect and collate all the data. The question whether the bed of the Indus has been very much lowered near Sukkur is only one item of the information to be gained, which would certainly provide valuable data in respect of the relations between rainfall and river flow, and the nature and extent of the changes in the beds of the rivers, caused by an extraordinary flood, such as may under normal conditions be awaited for half a century or more. Natural dams, storing large volumes of water, are of very rare occurrence. The information to be gained by a study of the conditions before, during, and after the flood, would be eagerly studied by river and irrigation engineers in all countries. After the great floods of a few years ago in Northern India, it was considered that the irrigation engineers were too busy to undertake such investigations, the staffs being "stretched" to deal with the damage caused by the floods. That decision may be deplored in view of the value of the data that might have been collected, and the availability of other engineers, well versed in hydrology and meteorology, who need only an experienced chief to show them how to cast their information into the desired forms. It is much to be hoped that the present opportunity will not similarly be allowed to pass. The best machinery for the purpose of such a study is an informal committee with a whole-time secretary, whose special qualifications for the appointment should be carefuly considered, in order that he might be relied upon to keep the investigations going between not too frequent meetings of the committee. The committee would, presumably, include the Chief Engineers of the Punjab, Sind, and the North-West Frontier Province, the Commanding Royal Engineers at Peshawur and Rawalpindi, and the Chief Engineer of Kashmir or his delegate. The chairman would, in the natural course, be the Consulting Engineer to the Government of India, unless etiquette should preclude that appointment, in view of the fact that the present consulting engineer is junior to most of the chief engineers. By whatever machinery the task of collecting and collating the data may be undertaken, it is to be hoped that the matter will receive the immediate attention of the senior officers concerned, and that full advantage may be taken of this very favourable opportunity of adding to the benefits which India has bestowed on the world in the field of river and irrigation engineering.

Technical Education from a Students' Point of View.

No. II.*

BY the time the first year course is over and the student has either passed the Intermediate B.Sc. or failed to do so, he has begun to realise that, if he is to get his degree, he must settle down to do some work. Every bit of work he does in the college earns marks towards obtaining for him the college diploma, which is frequently the equivalent of the degree or exempts him from the degree examination.

Thus both the public school man and the secondary school man settle down to work: the public school man is still ready to pick the brains of the other, but a sense of responsibility is arrising and he is more careful to discover how each problem is done. The student also finds that the amount of work he is expected to do is rather beyond his capacity. Of course, it is the average student who is under discussion; not those who are commonly known as "Brains." The average student seeks relaxation in the subjects less important from the examination point of view: possibly he fails to be regular in his attendance at such classes; and once having enjoyed truancy he may extend it to more important classes.

The student finds that he takes home with him each day a larger and larger amount of work; at first, being young, he is light-hearted about it; he is ready, on the slightest excuse, to put off till to-morrow what he ought to have done to-day. If he is regular he may be able to keep up to date by working a couple of hours every night and longer at the week-end. But when at last he "scrapes through" into the third year he is soon appalled by the amount of work he finds that he is expected to do. During the second half of the session, in order merely to keep up, the average student has to work four or five hours a night and a considerable part of the week-end as well. The "Brains" work less; but a problem that takes them ten minutes will take the average man half an hour. And even the "Brains" are over-worked.

The ages of the men at college vary from sixteen years to twenty-two years; surely it is hardly fair to expect a young man of eighteen or nineteen to work up to midnight every night and frequently well into the small hours of the morning? It is certainly dangerous to his health. The capacity for work of the young man should not be strained. The ideal education would be one that taught the student

* No. I. appeared Sept. 6th.

how to add to his knowledge and gave to him the base on which to rest later discoveries. It would not strain him in the process. Who would think of harnessing a young colt straight from the meadow to the heavy wagon which the grown horse hauls with difficulty? Or who would think of running a petrol engine, just put together, at full speed and full output for any length of time before it was properly run in? Yet the colleges do something closely analogous to this when "training" the young engineer. "Breaking" might be a better term!

The ideal education would give the student a very firm grasp of elements and a rather casual acquaintanceship with more advanced subjects. The basis of engineering is applied science; so the student should have a good knowledge of physics—elementary physics: for instance, he should know everything about reflection and refraction, but there is no need for him to be able to calculate the refraction of a coloured light through ice by somebody's atomic theory. All he needs to know, as yet, is that different coloured lights have different angles of refraction; and that the effect with daylight is to produce a spectrum when the beam of light is directed through a prism. If a student thoroughly understood the laws of refraction five minutes consideration would convince him, without any demonstration, that a positive lens could produce an image. So it is with all subjects; if the elements are thoroughly understood very little instruction will show the student how to proceed with more advanced problems; but if the elements are only hazily fixed in his mind, several hours' work may be necessary.

But turn to the actual syllabus of the present-day college; here there will be found a list of subjects that are considered essential to the training of the engineer. It will be easier to attempt to modify this than to try to tabulate from the ideal standpoint what should be taught. It is only necessary to bear in mind that the student ought to leave the college understanding that practice is at least as important as theory and having enough knowledge of the elements of his subjects to be able to expand his knowledge rapidly, if the need arises: there is not time for more.

The chief subjects for each year are tabulated below:—

MECHANICAL ENGINEERING COURSE.

First Year.

Heat Engines. Mechanics. Strength of Materials. Design. Shops. Physics. Chemistry. Mathematics.

Second Year.

Heat Engines. Mechanics. Mechanisms. Strength of Materials. Design. Laboratory. Mathematics. Electricity and Applied Electricity. Metallurgy. Hydraulics. Chemistry.

Third Year.

Heat Engines. Mechanisms. Strength of Materials. Design. Structures. Laboratory. Mathematics. Hydraulics. Electricity. Surveying. Fuels and Oils.

It will be seen that the syllabus is very wide; so it should be. But being so wide the study of most of the subjects should be elementary.

Among the first-year subjects there will be found "Shops." This item comprises work on a lathe and at a bench; pattern making; and the theory of workshop accounts and management.

Now it sounds very well that a student of engineering should do some practical work at college; but look into the matter further. After all the student has a great deal to do, and unless a subject is going to repay fully the time spent upon it, it should not be included in the syllabus. The time spent in the "shops" varies in the different colleges; as a maximum six hours a week is allowed for one year. The actual working year at college is not more than eight months; this gives a total time in the "shops" $= 8 \times 4 \times 6 = 192$ hours. There are three sections, lathe, bench, pattern shop, so that each "shop" has exactly 64 hours devoted to it—equivalent to ten days in the "works." In many colleges the time spent in the "shops" is less.

What can the average student learn in the equivalent of ten days in the works? The work is distributed over a number of three-hour periods and the student lacks the personal guidance of the "master craftsman," which he can only get in the works. Add to these arguments that his parents are sometimes expected to buy for him a complete set of tools at considerable expense, and it becomes plain that these classes are a waste of time and money.

Then there are the classes on Workshop Accounts and Management, in which a considerable amount of time must be spent in teaching the student something that he will learn as "he goes along" in the works. Incidentally, it is in a class like this that the innate good sense of the students shows; they fail to put in an appearance if they have something better to do!

There is nothing particularly striking in the list of subjects for the second year, but in some colleges Surveying is included in the third year. The mechanical engineer should know something of surveying; he ought to be able to use a level and a theodolite with intelligence, but why endeavour to teach an already overworked audience what Azimuth is or the Right Ascension of the Mean Sun, or for that matter all the corrections that must be applied to the reading of an aneroid in order to get the exact height of a mountain? Particularly, since the method is only approximate, anyway! These things are for the use of the civil engineer. To teach these things to the mechanical engineer is a waste of time that might be employed more profitably on subjects dealing with mechanical engineering.

Actually, the mechanical student is given a very thorough training in surveying, structural design, the theory of A.C. and D.C. electricity and hydraulics. It is so thorough that by the end of it he has forgotten a great part of the elements of these subjects. But the mechanical student requires to know little more than the very beginnings of the elements of surveying or of structural design; the practical side of A.C. and D.C. machinery will be of far more use to him than abstruse mathematical theory; if he comes up against *that* in his engineering career, he will send for the electrical engineer at once, whether he has a knowledge of advanced theory or not. Hydraulics is in a class by itself; it stands on the border line between mechanical and civil engineering. The writer's own view, for what it is worth, is that the study well repays the time spent upon it. The mechanical engineer uses water for many purposes and the more he knows about it, the better.

Most of these subjects which are not directly mechanical are taught by professors who are not mechanical engineers. They cannot be blamed therefore if they tend to carry the student further into their subject than is really necessary. It would be preferable that a mechanical engineer should take the students in all these subjects.

But the true reason why these allied subjects are taught so fully is because the syllabus of the B.Sc. demands this knowledge. The colleges have become schools at which young men may be "crammed" for the degree, and the syllabus of the degree settles the syllabus of the college. The colleges are not so much to blame for this, since their best advertisement is the percentage of their students who obtain a degree. But it cannot be denied that it is the professors at the colleges who set the standard of the degree, and it is the professors therefore who are to blame for making the time of training of the engineer over-long.

(To be continued.)

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Aluminium and Its Alloys.*

By Dr. A. G. C. GWYER, B.Sc.

THE outstanding feature of aluminium is, as every one knows, its lightness or low specific gravity, and it is very largely owing to this that it has come into such general use, and is hence produced to-day in a relatively large tonnage, although it possesses many other properties; for example, electrical, chemical and thermal, which render it of particular value for special purposes.

If one were asked to what to attribute the great increase which has taken place, say, during the last fifteen years, in the demand for and consequent production of aluminium alloys, the answer would, I think, be to the enormous strides which the development of modern transport has made, a development which has, on the one hand, caused engineers to explore all possible avenues for reducing weight, and, on the other, metallurgists energetically to search for new alloys and to try to improve the older and longer known ones. It is, as a matter of fact, rather in the latter direction that more progress has been made, as the number of new alloys which have come to the fore and at the same time established themselves is relatively small. So many investigations have been carried out and so much practical experience gained during this period, that the majority of the better known alloys can no longer be, and indeed no longer are, regarded as either new or unproved. It is mainly, though by no means exclusively, with these investigations that I am proposing to deal in this lecture.

Whilst it is comparatively easy to demonstrate the properties or usefulness of any new material, it is usually, if not invariably, far more difficult to prove its reliability and durability; indeed, it is hardly to be expected that until considerable practical experience has been acquired it should be possible to form an opinion with respect to these most important properties. One of the prime essentials for reliability, and this applies equally to all metals, is that it shall be sound; castings must be sound, no matter whether they are to be utilised as such or whether they are to be wrought into some particular form.

Now, aluminium, in common with many other metals, possesses a strong tendency to absorb various gases, a tendency which, if not watched and carefully checked, causes it to become more or less unsound. As a consequence, the founder, for example, is apt to experience difficulty in making castings free from pinholes. We are indebted to Czochralski for having carried out a most exhaustive investigation upon the capacity of aluminium for absorbing various gases over a wide range of temperatures. Instead of attempting to determine the nature and amount of gas given off, he determined the specific gravity of the metal, after passing an excess of gas over it, whilst in the molten state and maintained at various temperatures. He was able to prove that the resultant diminution in the specific gravity of the metal gave an accurate measure of the occluded gas by means of planimetric measurements. His curves show very conclusively how rapidly all the gases investigated are absorbed when a temperature of 900 deg. is exceeded, and how relatively small the absorption is at lower temperatures. The absorption is lowest in the case of nitrogen, and rises in the following order:—Carbon monoxide, air, oxygen, sulphur dioxide, coal gas and hydrogen. It is thus very obvious that to overheat the metal in the presence of gases, more especially furnace gases, is a practice to be carefully avoided; further precautions than this are, however, often necessary. As the great majority of commercial aluminium alloys melt at lower temperatures than aluminium itself, that is, below 659 deg., it might be thought that but little difficulty would be met in re-melting them, since there would be no object in raising the temperature to 800 deg., much less 900 deg., but this is not borne out by practical experience. The possibility of gases in detrimental amounts being taken up at moderate temperatures and not subsequently released upon cooling has to be reckoned with; indeed Bircumshaw considers that aluminium is very apt to take up hydrogen in particular at temperatures but little removed from the melting point. Gas evolution does not commence, not freely, at any rate, at the moment when solidification starts, but is delayed until the outer layers are solid and hence the absorbed gases tend to be driven to the interior and to collect in shrinkage cavities and pipes, if such there be.

When particularly sound metal is required, therefore, it may be necessary to observe more than the ordinary precautions of good melting practice and definitely to de-gas it, which can be done in various ways. Archbutt has investigated this subject very thoroughly and successfully. When the rate of solidification is rapid, as in chill casting, the gases tend to be retained in solution in the solid metal; at intermediate rates the gas certainly tends to come out of solution, but then it becomes entrapped and gives rise to pinholes. It is only when the rate of solidification is sufficiently slow that the gases are liberated and the solid metal freed therefrom. Archbutt came, therefore, to the conclusion that it would be best to allow the molten metal to solidify extremely slowly

* The Institute of Metals, Eighth Annual Autumn Lecture, Düsseldorf, September 10th, 1929.

in the crucible and, after allowing it to become perfectly solid, to re-melt carefully and raise the temperature no higher than absolutely necessary. His method has now been well tried out, and is followed by many founders. Archbutt also found that the alloying metals, rather than the aluminium, were sometimes at fault, and that it often sufficed to de-gas the so-called "hardener" alloys only. I have had considerable experience of his method, and have found that a modification which has advantages in special cases is to de-gas by pouring the metal into block form in hot and well-dried sand moulds provided with a suitable lid, also of hot and well-dried sand. The resultant blocks can subsequently be stored until required for re-melting.

There are various other methods of degasification, such, for example, as by bubbling an inert gas, say, nitrogen, through the molten metal. This was first suggested by our President, and is a method which has also found favour among practical men. One of the latest methods is that described by Tullis, who has found that the passage of an active gas, such as chlorine, is very effective in eliminating the dissolved gases. There is thus at the present time a considerable choice of methods for combating what was formerly a serious and troublesome problem.

Corrosion and Protection.

Another direction in which considerable advances have been made is in connection with our knowledge of the corrosion of metals in general, and, in particular, to methods of protection against corrosion in aluminium, thanks to the early work of Heyn and Bauer, Seligman, Bengough, Evans, &c., to which, however, I have no time to refer in detail. On the theoretical side, I consider a very marked advance has been made by the recognition of the most important part played by surface films, both in promoting

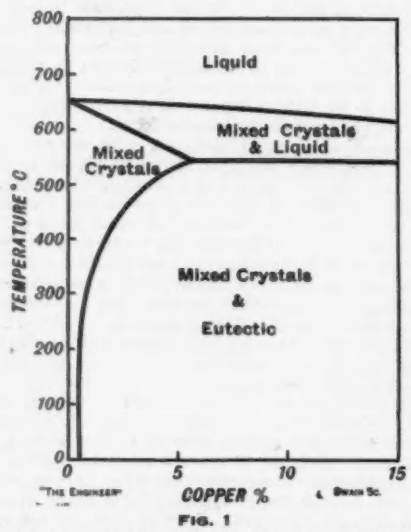


FIG. 1

Aluminium-copper Alloys (Dix and Richardson, and Stockdale)

and in retarding corrosive action. "Passification" of metals has been recognised for some time, although there is still some difference of opinion as to whether it is brought about by the formation of gaseous or solid films at the metal surface. Evans has recently succeeded in proving the presence of solid films, and has been able to give methods for their isolation and examination, and Callendar has shown that the local corrosion of metals in normal waters is governed very largely by the presence of boundary films of either a solid, liquid, or gaseous character on the metal surface. In the case of aluminium, what is still wanted is a satisfactory method or methods for measuring the extent of corrosion, as such comparatively simple methods as the "loss in weight," or "loss in tensile strength" methods have been of little real service, as they fail to distinguish between general and local corrosion or "pitting." Two tests, both due to Mylius, must, however, be mentioned. The first consists in immersing the specimen in hydrochloric acid contained in a flask under standard conditions, and in measuring the rise in temperature of the acid, it being assumed that the reaction velocity in such circumstances may be taken as a measure of the corrodibility. In the second test, a sample of standard area is immersed in a solution of sodium chloride of given concentration, to which a definite amount of hydrogen peroxide has been added. After twenty-four hours the aluminium hydroxide which has been precipitated is filtered off, ignited and weighed, but it is questionable how far this test gives a measure of the total action, since it appears to take account solely of the non-adherent deposit or scale. It is much to be hoped that the valuable researches of Bengough upon zinc will be extended to aluminium, as they are of a highly fundamental character. Bengough and his colleagues have devised an ingenious and special form of apparatus in which the corrosion is allowed to proceed under accurately controlled conditions, so that the quantity of oxygen absorbed can be determined quantitatively.

With regard to methods of protection, very remarkable progress has been made. There are now a variety of paints, collodion lacquers, varnishes and cellulose mixtures which give highly satisfactory results, always provided that care is taken to produce a thin and closely adherent coating free from pinholes. It is interesting to note that aluminium paint, which has long been in use for painting iron objects, such as lamp posts, tramway standards, &c., affords excellent protection when sprayed on aluminium castings. It has also been found that the practice of dipping either in water-glass (sodium silicate solution) or lanoline forms a useful precursor to painting proper.

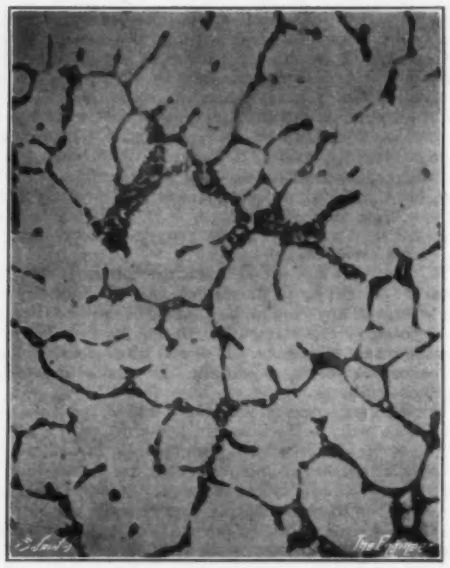


FIG. 2

2L8 Alloy.—12·45 per cent. Copper, 0·28 per cent. Iron, 0·29 per cent. Silicon. Chill Cast. Etched with Ferric Nitrate. Primary Aluminium and $CuAl_2$. × 200.

When the former process, which was developed in America by Zimmerman and Daniels, is followed, the castings or other objects must subsequently be baked for a couple of hours at 150 deg.

One of the most successful and important methods of protection is based upon the principle of causing the metal to build up its own protective film, as, for example, in the case of the so-called "anodic oxidation process," devised and patented by Bengough and his colleagues. The process consists in making the finished article the anode in a bath of chromic acid, the voltage being raised slowly to 50 volts,

FIG. 3

10 per cent. Copper, 1 per cent. Iron. Slowly Cooled. Etched with Caustic Soda. Aluminium, $FeAl_3$ (dark), N (needles), $CuAl_2$ (half tone). × 200.

whereby an extremely thin and tenacious coating of oxide is produced, which is extraordinarily resistant to the action of sea water. Another and rather similar process has been patented by Jirotka; here a protective film is formed by simple immersion in a heated solution of carbonates and other salts, no electromotive force being applied, but the films so produced are much thinner and rather less resistant under severe conditions. In America the most recent development makes use of the fact that very high purity aluminium is practically non-corrodible. A composite metal is produced, the outer layer consisting of very high purity aluminium, and one of the principal advantages claimed for this procedure is that the protective action of the coating extends over any portion of the metal base, which may have become exposed by abrasion or cutting.

The possibility of alloying with some element in order to raise the resistance to corrosion has been and is being also actively investigated. For example, in Germany the addition of antimony in comparatively small amount has been found to give rise to a highly protective film, which is rapidly re-formed after abrasion, &c. The modern high-silicon alloys, to which I shall be referring again at greater length, are also good from the standpoint of corrosion.

Constitution.

We will proceed now to the consideration of the constitution of some of the more important aluminium alloys, the major proportion of which will be found to be covered by the following broad classification:—

(1) Alloys with copper.
(2) Alloys with copper and zinc.
(3) Alloys with silicon, both without and with copper, of which the last group, the silicon alloys, constitutes really the only radical novelty of the last decade.

I have already indicated that all the more important alloys have now been very thoroughly investigated, and this is true particularly with respect to their constitution, but before referring to this I must shortly outline what is known of the constitution of the basis metal, for ordinary commercial aluminium is essentially an aluminium-rich ternary alloy with silicon and iron.

All the earlier work was chiefly concerned with the determination of the constitution under conditions of more or less complete equilibrium, and rightly so, as this must form the basis of all constitutional studies; but practical experience has driven every worker in

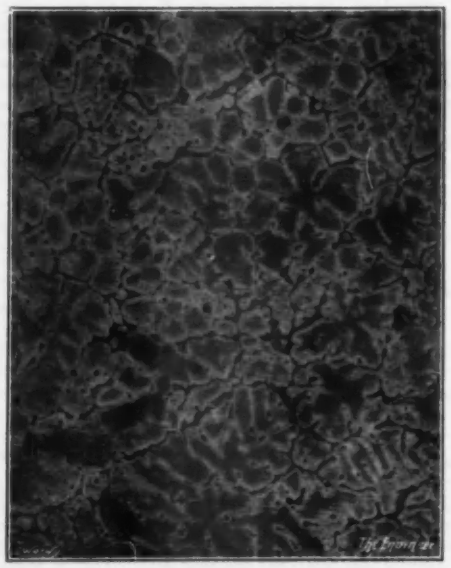


FIG. 4

20 per cent. Zinc. Chill Cast. Etched with Hydrofluoric Acid. × 100.

this field to the conclusion that neither in the cast nor wrought states is aluminium or its alloys ever, if indeed at all, in a state of structural equilibrium. It follows, therefore, that in order to acquire a full and complete knowledge of the constitution both metastable as well as stable conditions of equilibrium must be studied.

Aluminium and silicon form an eutectiferous system, with a limited degree of solid solubility at the aluminium end, so that all aluminium contains at least some silicon in solid solution. The curve of solid solubility extends from 1½ per cent. at 577 deg. to in all probability less than ·01 per cent. at room temperature, according to the recent work of von Göler and Sachs and of my colleagues, so that under all ordinary conditions aluminium is always supersaturated to some extent with silicon. This is of much practical import, because the condition of the silicon affects the properties, notably the electrical conductivity, and so needs to be controlled by appropriate heat treatment.

Aluminium and iron, unlike aluminium and silicon, form a very complex system when the iron content is over 40 per cent., but with less than this the alloys are all eutectiferous, the two components being aluminium and a compound corresponding to the formula $FeAl_3$. Iron, again in contradistinction to silicon, is completely insoluble at all temperatures in solid aluminium, so that its effect on the properties can only be additive. It is interesting to note in passing that the very characteristic and strong expansion upon solidification shown by certain aluminium iron alloys, which gives rise to so-called "warts" upon the surface, has lately been re-investigated fully by Masing and Dahl and proved to be entirely due to the liberation of gas. Apparently the compound $FeAl_3$ has a strong tendency to take up gases when molten.

Commercial aluminium always contains more or less silicon and iron, and the stable and metastable relationships are moderately complex. In addition to free $FeAl_3$ and free and dissolved silicon, there may also be present two solid solutions, known respectively as X and β, and each containing aluminium, silicon and iron. The constituent X has been shown by our President and his co-workers to be a stable reaction product, whilst the work of my colleagues has shown that β when found in commercial aluminium is a metastable body, although in certain regions of the ternary system much richer in silicon and iron it can become fully stable. It is very important to be able to recognise all these constituents, not merely because they occur in commercial aluminium, but because they may also be met in aluminium alloys and exert an influence upon their properties. It is not possible to show you a microsection of commercial aluminium containing all of these constituents, for the reason that the structure of the metal depends upon the composition. In metal containing 0·25 per cent. Si, 0·75 per cent. Fe, the constituents present are $FeAl_3$ and the solid solution β. If the content of iron is decreased and that of silicon increased the structure of an alloy containing 0·75 per cent. Si, 0·50 per cent. Fe, for example, shows that β replaces $FeAl_3$ as the binary separation. At a lower temperature β reacts with the liquid present to form the stable constituent X.

We can now consider the constitution of certain of the aluminium alloys in so far as it is concerned with those in common use.

Aluminium Copper.

As 14 per cent. is the maximum content of copper in commercial alloys, it is only necessary to show a portion of the constitutional diagram—see Fig. 1—

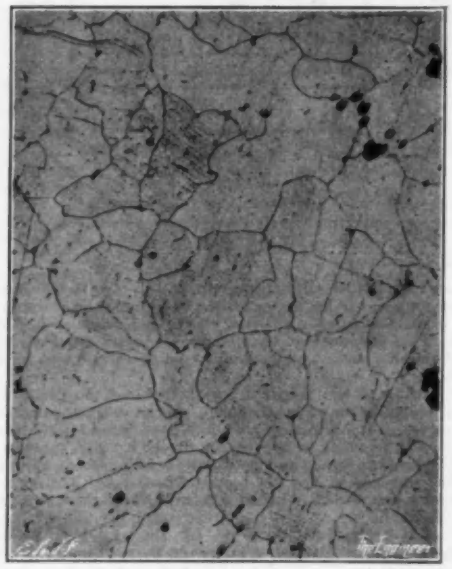


Fig. 5

20 per cent. Zinc. Chill Casting same Alloy as Fig. 4, but Annealed for Twenty-four Hours at 500 deg. Cent. and Quenched. Etched with Hydrofluoric Acid. × 100.

as determined by Dix and Richardson and by Stockdale. In this region two constituents only are found, namely, an aluminium-rich solid solution which may contain, according to circumstances, from ·3 to 5½ per cent. copper, and an eutectic consisting of this solid solution and the compound $CuAl_2$. The two commonest alloys are those containing 6/8 per cent. and 12 per cent. copper respectively, each containing the same two constituents—see Fig. 2—although the copper-richer alloy is richer in eutectic. There is also a third alloy—Fig. 3—in common use in America containing 10 per cent. copper, and which is intentionally high in iron, the iron content being of the order of 1¼ per cent., but this is really a quaternary alloy, because the iron is present not only as $FeAl_3$, but also as a solid solution with aluminium and silicon which is now designated by the letter N. The section shows the structure of a slowly cooled alloy.

Aluminium-Copper-Zinc.

Aluminium alloys with copper and zinc are very popular in Europe, much more so than in America, but alloys with zinc alone are scarcely ever used. In order, however, to appreciate the effect of the addition of zinc, we must first consider the aluminium-zinc binary system, in which, according to Hanson and Gayler, the two metals form a solid solution γ, rich in aluminium. The solid solubility of the zinc falls from 70 per cent. at 440 deg. to 17 per cent. at room temperature, and the structure of the alloys—Fig. 4—in this range is typical of that of solid solutions generally, showing—Fig. 5—in the cast condition "coring," which is only removable by long annealing. Even when the zinc content exceeds 17 per cent. and a duplex structure would from the diagram be anticipated, the alloys remain unchanged in appearance because the deposition of α from γ proceeds with such extreme sluggishness as to be imperceptible under the microscope.

As previously mentioned, it is the ternary alloys which are of importance, and of these by far the most important is the alloy with 3 per cent. copper and 13 per cent. zinc—Fig. 6. Here, again, however, the alloys of commerce are not truly ternary alloys, and a constituent due to the presence of iron is always to be seen.

Aluminium-Silicon.

Aluminium-silicon alloys are by no means new, having been described as long ago as 1856 by Deville,

Fig. 6

2L5 Alloy.—3 per cent. Copper, 13 per cent. Zinc. Sand Cast. Etched with Ferric Nitrate. $CuAl_2$ (dark), iron constituent (half-tone). × 300.

but as it was thought until quite recently that silicon in aluminium was harmful, they attracted no serious attention. They commenced, however, to assume commercial importance in 1920, when Pacz discovered that by the addition of a small quantity of a powder consisting essentially of an alkaline fluoride to the molten metal, the mechanical properties were greatly improved, and that the fracture, instead of being coarse, became very fine grained.

As prepared by direct fusion of the two elements together, the alloys are of very little importance; these are the so-called "normal" alloys. When,

Fig. 7

9·86 per cent. Silicon, 0·45 per cent. Iron. Chill Cast. Unetched. × 200.

however, the molten alloys are treated with one or other of the patented and so-called "modifying agents," a reaction takes place, and upon solidification it is found that a profound change in both the structure and properties has occurred. The effect of "modification" is to increase enormously the dispersion of the silicon—indeed, it is no uncommon thing to find the eutectic so fine as to be resolvable under the microscope with the greatest difficulty.

The "modified" alloys also form an eutectiferous series, but the eutectic composition varies and may attain as much as 15 per cent. silicon, whilst its freezing point may be lowered by as much as 16 deg., depending upon the conditions of "modification" and the rate of cooling.

"Normal" alloys with less than 11·7 per cent. silicon consist of primary aluminium solid solution plus coarse eutectic, the silicon being in the form of needle-shaped crystals. When "modified," an alloy of exactly the same composition—10 per cent. silicon—presents a strikingly different appearance. It will be seen that the primary solid solution crystals have assumed a markedly dendritic aspect, and that the eutectic is now exceedingly fine grained—see Figs. 7 and 8.

Various theories have been advanced to account for the changes brought about by "modification," but further experimental work will be required in order to explain them really completely. My colleague Mr. Phillips and I are of the opinion that the whole phenomena can best be explained upon the assumption that the silicon and aluminium particles at some stage during the cooling to solidification assume colloidal dimensions, and that the "modifying" agent functions as a colloid protector. Whatever the truth may ultimately be found to be, it is worth while to point out, in passing, that the principle involved in "modification" is by no means restricted in its application to aluminium-silicon alloys. Thus, we found that lead-antimony alloys were capable of "modification," and that the structural changes effected were very closely similar to those observed with the aluminium-silicon alloys.

The addition of copper to relatively low silicon alloys has been tried with success during recent years. In Germany an alloy with 4 per cent. copper and 2 per cent. silicon has come to the fore under the name of "Lautal," and an alloy of similar type is also standard now in America. These alloys, both in the cast and wrought states, are susceptible of con-

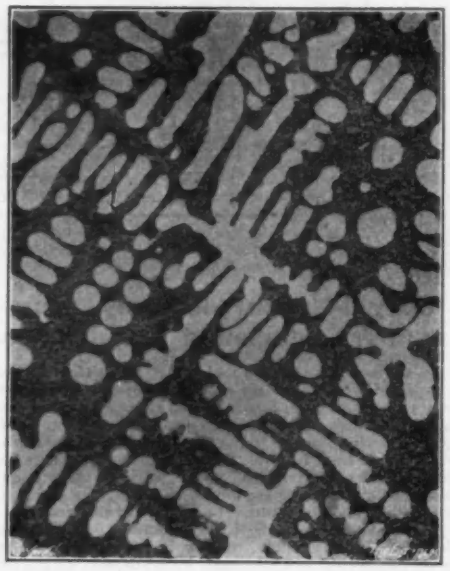


Fig. 8

9·86 per cent. Silicon, 0·45 per cent. Iron. Same Alloy as Fig. 7, but Modified with 5 per cent. NaOH at 750 deg. Cent. Chill Cast. Etched with Hydrofluoric Acid. × 200.

siderable improvement by heat treatment, as I shall be mentioning later. Although the constitution of the aluminium-copper-silicon system has not yet been completely investigated, the structure of the aluminium-rich alloys has been worked out.

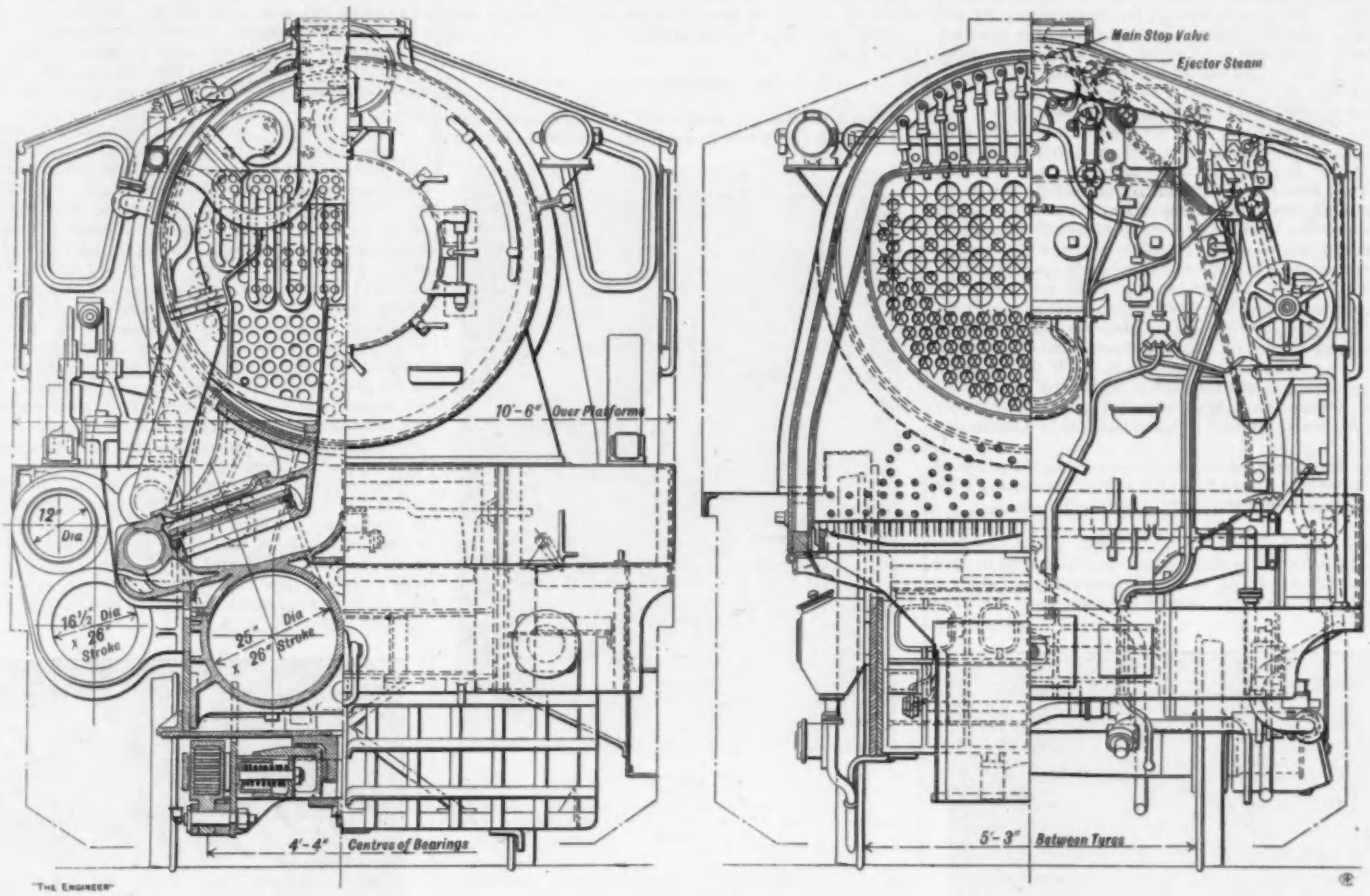
They form an eutectiferous series with appreciable solid solubility. Aluminium is capable of dissolving up to 5 per cent. Cu and 1·5 per cent. Si at the eutectic temperature, 540 deg., the solubility being less at lower temperatures. The eutectic consists of the aluminium-rich solid solution, silicon and the compound $CuAl_2$.

(To be continued.)

The timber decking of the Haraban Bridge over the river Mississippi, at Memphis, was recently destroyed by fire, but the main trusses did not suffer much damage. It was decided therefore to replace the twenty-seven panels of damaged floor system and allow traffic to cross on the downstream track, and later to repair the three sections of bottom chord by cutting out the buckled parts of the webs and splicing in new sections of silicon steel of approximately the same strength. The only difficulty in this process was the putting of the initial dead load stress into the spliced web, and this was accomplished, according to the *Engineering News-Record*, by the method of "short pinning." The new piece of web was drilled in the field so that the connection holes were ⅛in. excentric with the holes in the existing web. One end of the splice was then made firm and the other end gradually was drifted into place with drift pins until the excentricity was removed, and the holes came true. It was considered that ⅛in. would be lost in this process, but that the remainder of ⅛in. would be the actual deformation of this web, corresponding to a stress of about 9000 lb. per square inch, which was the designed deadload stress.

BENGAL-NAGPUR RAILWAY—FOUR-CYLINDER COMPOUND LOCOMOTIVE

NORTH BRITISH LOCOMOTIVE COMPANY, LTD., GLASGOW, ENGINEERS



Bengal-Nagpur Railway—Four-cylinder Compound Locomotives.

In the earlier years of this century when the De Glehn compound locomotive had attained considerable celebrity on the Continent, the North British Locomotive Company, Ltd., built two test locomotives on this system—4–4–2 type—for the express traffic of the Bengal-Nagpur Railway. Since then further orders for thirteen engines have been supplied, and the successful work of these engines has resulted in an order for eighteen engines of a more powerful class, which form the subject of this article.

These new engines are of the "Pacific" or 4–6–2 type; they have four cylinders, and can be worked either simple or compound. The wheel base, frame details, spring gear, &c., conform to those of the I.S.R. "Pacific" type "X C" class.

The high-pressure cylinders are fitted on the outside of the frames, and drive the second coupled axle. They are 16½in. diameter by 26in. stroke, and have 12in. diameter piston valves, by-pass valves, and a change valve. The exhaust outlet is connected to the change valve chamber, which forms part of the low-pressure cylinder casting. The change valve is power-operated by means of an auxiliary steam valve—controlled from the cab—which, when the engine is working "simple," supplies boiler steam to the low-pressure cylinders.

The low-pressure cylinders, 25in. by 26in., are fitted inside the frames, and are formed in one casting with the smoke-box saddle—see page 278. As will be seen from another illustration on that page and the Supplement, they drive the leading coupled axle. The slide valves are of the balanced type, with steam chests so arranged as to provide for easy accessibility to the valves. Each cylinder has its own separate Walschaerts valve gear. The reversing gear is of the screw type. Cylinder lubrication is provided by means of two four-feed Eureka S.F. lubricators.

The coupling and connecting-rods are made of nickel-chrome steel in order that, for wheel-balancing purposes, they may be made as light as possible. Nickel steel is used for the barrel plates of the boiler, but the fire-box is of copper. It has an extended combustion chamber and circulation tubes are fitted under the brick arch. The feed is effected by two injectors under the footplate, delivering to a top feed valve at the front end of the boiler.

Owing to the height of the boiler and the limitations imposed by the structure gauge, special short design safety valves, of the Ross pop type, had to be fitted; they stand, as will be seen, on top of the fire-box. The grate is of the rocking type, and is operated by a steam cylinder. On the side of the fire-box is fitted a small generator, which supplies current for a Stone's headlight and for the cab lights.

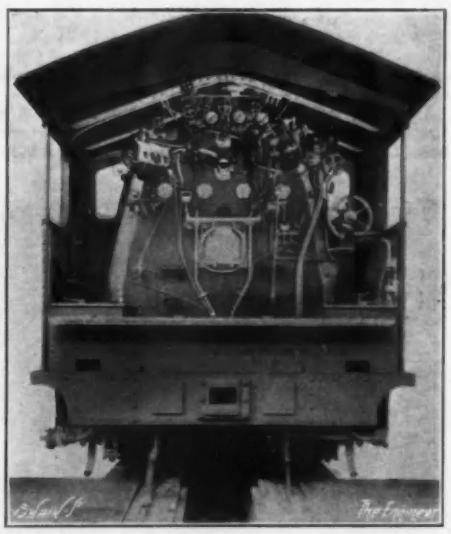
The brakes are operated by the standard vacuum equipment with steam cylinders on the engine and vacuum cylinders on the tender. Lambert wet sanding gear is fitted to the leading and trailing coupled axles.

The principal dimensions are as under:—

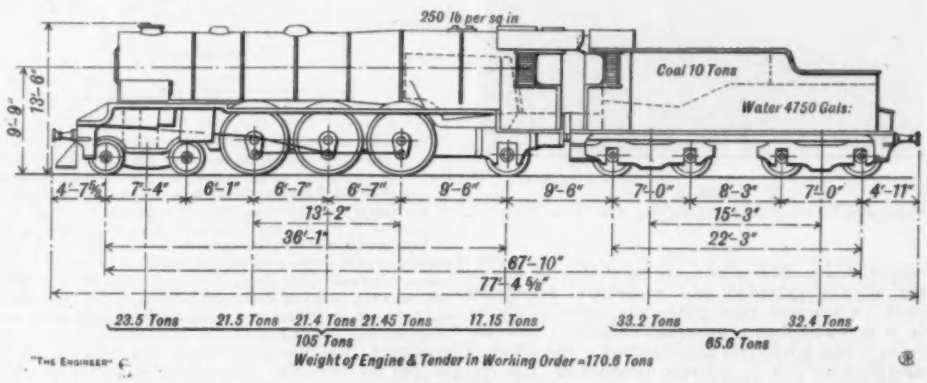
Gauge	5ft. 6in.
Coupled wheels	6ft. 2in. dia.
Two H.P. cylinders	16½in. dia. by 26in. stroke
Two L.P. cylinders	25in. dia. by 26in. stroke
Boiler working pressure	250 lb.
Heating surface—	
30 flue tubes	799 sq. ft.
129 small tubes	1405 ,,
Four arch tubes	24 ,,
Fire-box	211 ,,
Evaporative, total	2439 ,,
Superheater	637 ,,
Total	3076 ,,
Grate area	51 ,,
Total weight in working order, engine:—	
Bogie	23·5 tons
First driving wheels coupled	21·5 ,,
Second driving wheels coupled	21·4 ,,
Trailing wheels coupled	21·45 ,,
Trailing wheels carrying	17·15 ,,
Total for engine	105·0 ,,
Total weight in working order, tender:—	
Leading bogie	33·2 tons
Trailing bogie	32·4 ,,
Total for tender	65·6 ,,
Total weight in working order, engine and tender	170·6 tons
Tractive effort (simple), 80 per cent. in H.P. cylinders and 34 per cent. in L.P. cylinders, equals	38,000 lb.
Tractive effort (compound), equivalent to 60 per cent. in four cylinders, equals	28,700 lb.

The tender is of the standard I.S.R. design, with a water tank capacity of 4750 gallons and a coal bunker capacity of 10 tons.

These locomotives are under construction at the Hyde Park Works of the North British Locomotive Company, Ltd., and are being built to the specifications and under the supervision of the consulting engineers, Sir John Wolfe Barry and Partners, and to the requirements of the chief mechanical engineer, Mr. G. Cunningham, M.B.E.



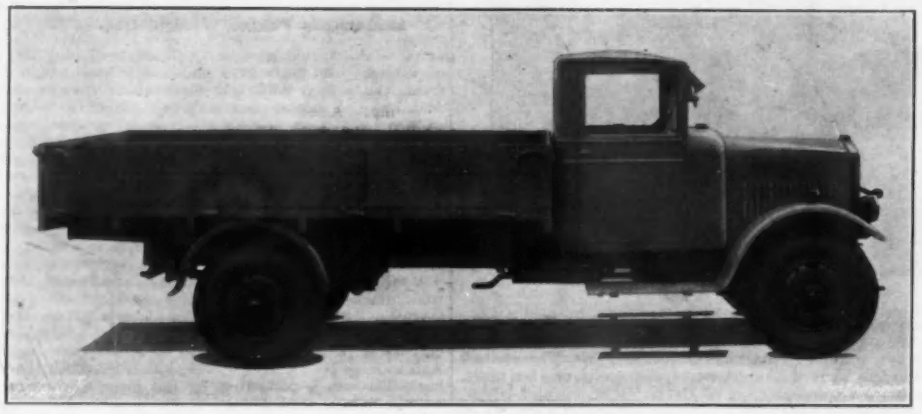
THE CAB



WEIGHT DIAGRAM

A New 50-Cwt. Commercial Vehicle.

THE photograph which we reproduce below illustrates a new type of commercial motor chassis of 50 cwt. nominal capacity, which has just been produced at the works of Bean Cars, Ltd., Tipton, near Birmingham. As will be seen, it is of the pneumatic tired class, and is noteworthy on account of the large clearances beneath the body and axles. It has, in fact, been primarily designed for colonial service, and the makers have been at great pains to find out from practical experience the best arrangements to meet the arduous conditions of overseas service. Thus, after long consultations with their local representatives, the makers evolved what appeared to be the best possible specification, and then built half a dozen or so chassis. These machines were sent abroad with instructions to the agents to submit them to the hardest possible usage. The reports on their behaviour were then used as a basis for the final specification, to which the vehicle we illustrate has been manufactured. It is noteworthy, however, that a large number of the suggestions put forward in these reports had already been anticipated by the designing staff.



50-CWT. MOTOR VEHICLE FOR OVERSEAS SERVICE

The result has been the adoption of a four-cylinder engine, with a mono-bloc casting, with a bore of 95 mm. and a stroke of 130 mm. The piston displacement is 3685 c.c., and the Treasury rating 22·8 H.P. The compression ratio is 4·8 to 1. The cylinder head is detachable, and is designed to give a high degree of turbulence to the combustible mixture, so that, with the masked inlet valves, a high degree of efficiency is attained, despite the comparatively low compression ratio, and any grade of petrol may be used. The valves are of Hadfield's Non-Stain steel, which is specially resistant to the effects of heat.

The gear-box gives four speeds and a reverse, and is equipped with wheels which have their teeth ground after being hardened. Arrangements are made so that a connection can be made at the gear-box for using the engine to drive any machinery and a tire pump is also driven off the box. There are a separate motor and a dynamo for starting and for lighting. The cooling of the engine is effected on the thermo-syphonic system, and a small section of the radiator is set aside for cooling the lubricating oil. The lubrication of the spring shackles and such parts is effected through a series of small copper pipes, which are brought to convenient central positions. The springs are of the semi-elliptic type, of Hadfield's special spring steel, and are 40in. by 2¾in. in front and 56in. by 3in. behind. The wheels have tires 36in. by 8in.

The chassis is made with a wheel base of either 13ft. 1½in. or 11ft. 1½in. In both cases the track is 4ft. 8½in., and the ground clearance 10½in. The height of the frame, when laden, is 2ft. 7½in.

THE ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX.

THE programme of the sixth annual Conference of the A.S.L.I.B., which is to be held during next week end at Trinity College, Cambridge, is as follows :—

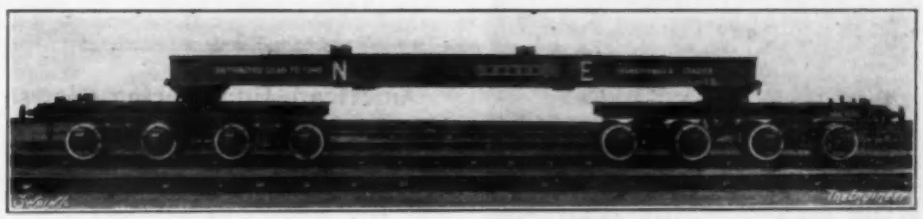
Friday, September 20th.—Afternoon, visits ; 6.45 p.m., reception of delegates by the Council of the Association ; 7.15 p.m., dinner, address by the President-elect of the Association (Sir J. J. Thomson, O.M., F.R.S.) ; 8.30 p.m., general session, chairman, Mr. H. L. Jackson. (1) "The Year's Work of the Association," by Brigadier-General Magnus Mowat, C.B.E., M. Inst. C.E., M.I. Mech. E. ; (2) "The Approach of the Producer to the Consumer of Information," by Mr. Laurie Magnus.

Saturday, September 21st.—10 a.m., Sectional meetings. (*a*) Chairman, Sir J. J. Thomson, O.M., F.R.S., "The Preservation of Places of Natural Beauty and Historic Interest," by Mr. S. H. Hamer (secretary, the National Trust). (*b*) Chairman, Mr. B. M. Headicar, F.L.A. (librarian, London School of Economics) ; (1) "Duplicating Machinery : A Survey of Modern Methods," by Mr. Albert Parker (Management Research Groups) ; (2) "Duplication and Infringement of Copyright," by Mr. E. J. MacGillivray, B.A., LL.B., Cambridge ; (*c*) chairman, Mr. H. M. Cashmore (Birmingham Public Librarian) ; "The Ideal Form of a Journal from the Librarian's Point of View," by Dr. W. Bonser, B.A. (Birmingham University librarian) ; afternoon, free, visits ; 5.30 p.m., annual general meeting ; 8.30 p.m., sectional meetings ; (*a*) chairman, Mr. F. A. Hoare (National Union of Teachers) ; "Books *versus* Text-books, the Problem of the Schools," by Mr. G. T. Hankin, H.M.I. ; (*b*) chairman, Mr. Hugh Quigley (British Electrical and Allied Manufacturers' Association) ; (1) "Organised Information in the Printing Trade," by Mr. R. A. Austen-Leigh, M.A. ; (2) "Technical English," by Mr. E. W. Ashcroft (of *World Power*) ; (*c*) chairman, Dr. E. E. Lowe, B.Sc., F.L.A. ; (1) "The Information Service of a Public Library," by Mr. E. Green, F.L.A. (Halifax Public Librarian) ; (2) "The Information Service of a Bank," by Mr. P. A. Green (Canadian Bank of Commerce).

Sunday, September 22nd.—10 a.m., sectional meetings ; (*a*) chairman, Dr. E. A. Baker, M.A. ; (1) "The Training of Special Librarians," by Mr. A. F. Ridley, F.L.A. ; (2) "Indexing and Classifying of Individual Collections of Data," by Mr. H. Rottenburg, M.A., M.I.E.E. ; (*b*) chairman, to be arranged ; (1) "Sources and Application of Business Data," by Mr. A. P. L. Gordon ; (2) "An Indexing System for Published Business Information," by Mr. E. T. Elbourne (hon. director, Institute of Industrial Administration) ; and Mr. H. G. T. Cannons, F.L.A. (Finsbury Public Librarian) ; afternoon, free ; 8.30 p.m., general session ; (1) chairman, to be arranged ; "International Organisation of Information Services," by Monsieur P. Otlet (Institut International de Bibliographie) ; (2) chairman, Dr. R. S. Hutton ; reports from sectional meetings ; resolutions ; votes of thanks.

Conveyance of Large Transformers.

IN connection with the national electricity schemes, it has been necessary to transport a number of large electrical transformers, and to cope with this traffic, the London and North-Eastern Railway Company in November, 1928, constructed a special wagon at Darlington, to the design of Mr. H. N. Gresley. This special wagon consisted of two main girders and pivotal bolsters mounted on two existing six-wheeled 40-ton flat wagons, this expedient being resorted to in order to meet the urgent requirements then existing, time not permitting of new wagons being built. This wagon was restricted to loads up to 66 tons in weight, but the girders and pivotal bolsters were designed to carry distributed loads up to 70 tons in weight, and in July of this year were removed from the 40-ton flat wagons and mounted on two double-bogie trucks, thus improving the axle loading and allowing the maximum load to be carried.



70-TON WAGON FOR TRANSPORTING TRANSFORMERS

The width between the main girders is adjustable, and loads up to 19ft. long and from 3ft. 6in. to 7ft. 6in. wide can be accommodated.

The wagon, which is illustrated herewith, has been specially designed to facilitate loading and unloading where crane power is not available. The unloading procedure is as follows : the weight of the transformer is first taken by lifting jacks and packings, and the side girders are moved laterally by means of the adjusting screws. Two rolling struts with which the set is provided are then fixed in position, and the main supporting bolts removed, thus enabling one carrying wagon and the girders to be drawn clear of the load.

The following are the principal dimensions :—

Length over buffers	65ft. 6in.
Length over headstocks	62ft. 6in.
Centre to centre of carrying trucks	40ft.
Length between trucks	20ft. 6in.
Maximum length of transformer to be conveyed	19ft.
Buffer height	3ft. 5½in.
Diameter of wheels on tread	2ft. 9in.
Maximum width over main girders	9ft.
Maximum width between main girders	7ft. 6in.
Minimum width between main girders	3ft. 6in.
Height to top of main girders	7ft. 9½in.
Height to top of transverse securing girders	8ft. 5½in.

The tare weight of the complete wagon set is 40 tons.

SYDNEY ELECTRICITY SUPPLY.

THE Sydney Electricity Department has grown rapidly in the last few years. It supplies no electricity for traction, as the Government Railway Department has its own generating stations supplying the suburban railways and tramways ; but it sold last year 300 million kilowatt hours, and this year will sell approximately 350 million kilowatt hours. It supplies electricity direct to over 170,000 separate consumers, besides supplying in bulk eight municipal and shire councils, which have connected to their supply mains an aggregate of 17,100 separate consumers.

The first section of the Sydney Power Station at Bunnerong, comprising six 25,000 kW turbo-alternators, eighteen 100,000 lb. to 120,000 lb. per hour boilers, step-up transformers, and a large installation of 30,000 volt switchgear, will be entirely completed before the end of the current year. The first units of the plant have been in commercial operation since January last, and in July last the station was generating at the rate of five million units per week.

To provide for the growth in demand, it has been decided to add one 25,000 kW turbo-alternator to the plant to come into commercial operation early in 1932 ; this turbine will draw its steam from the existing boiler-house plant.

By the winter of 1933 further additions must be made to the generating plant. These additions will comprise two 50,000 kW turbo-alternators, the first to be completed in 1933 and the second in 1934, with sufficient boiler-house plant, step-up transformers, E.H.T. switchgear, &c.

We are informed by Messrs. Preece, Cardew and Rider, of 8, Queen Anne's Gate, Westminster, that to ensure that the specifications covering this plant may be up to date, Mr. H. R. Forbes Mackay, general manager of the Sydney Electricity Department, is to visit Great Britain, Europe and America and acquire information. He is expected to arrive in London on October 21st, and will remain in Europe for about eight weeks.

B.E.S.A. SPECIFICATIONS.

STEEL PLATES, SECTIONS, BARS, and RIVETS FOR RAILWAY ROLLING STOCK.

A revised edition of Part 6 of Report No. 24, B.S. Specifications for Railway Rolling Stock Material, has just been issued by the British Engineering Standards Association. The particular specifications included in this part, and therefore covered by the present revision, are Nos. 16, 17, 17A, 18, and 18A, Steel Plates, Sections, Bars, and Rivets for Locomotives, Carriages and Wagons.

The Committee responsible for the revision has kept in view the desirability of unifying and so reducing the number of the grades of material, and accordingly the tensile strength of some of the material has been slightly modified as follows :—

(i.) For Sectional Material for Locomotive Boilers the tensile strength has been extended, and is now 26 to 32 tons per square inch.

(ii.) For Ordinary Plates and Sectional Material for use in Locomotives, Carriages, and Wagons, the minimum tensile strength has been lowered, and is now 26 to 32 tons per square inch also.

Temper Bend tests have been deleted from all the specifications, as it was considered that this test was of little importance for indicating the quality of the material.

In all the specifications other than that for steel for Locomotive Boilers—*i.e.*, No. 16—the following two important amendments have been made :—

(*a*) Provision has been made for a material with a tensile range of 24 to 28 tons per square inch, which can be used for welding, cold flanging, cold pressing, and cold working.

(*b*) It is now specified that Bend Tests only shall be taken on all material—other than rivet bars—less than ⅛in. thick. The bend test for this material has consequently been increased in severity.

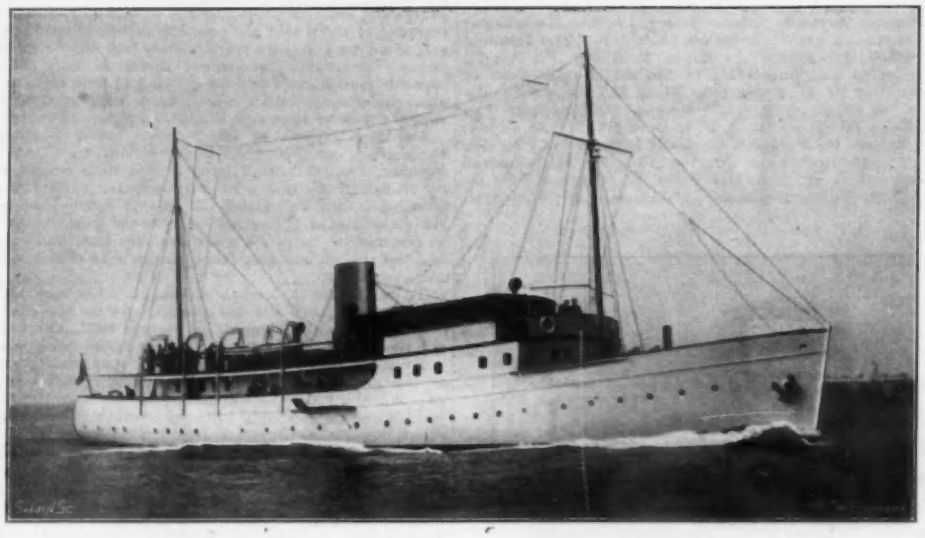
Other minor modifications and additions have been made to several of the requirements common to all the specifications to render them more clear and also to bring them into line with normal engineering practice.

Copies of the Specification 24, Part 6, 1929, can be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

DURING use in airships, helium escapes and air enters through the walls of the gas cells ; therefore, at intervals, the helium in an airship must be removed, purified, replenished, and put back. Three helium purification plants have been designed by the American Bureau of Mines, and constructed under its direction. The first of them is a stationary plant at Lakehurst, N.J., built for the Navy ; the second, a mobile plant mounted in a railway car, built for the Army ; and the third is a stationary plant for the Army erected at Scott Field, Ill. The Scott Field plant is capable of purifying 10,000 cubic feet of helium per hour.

THE TWIN-SCREW MOTOR YACHT "ROSA"

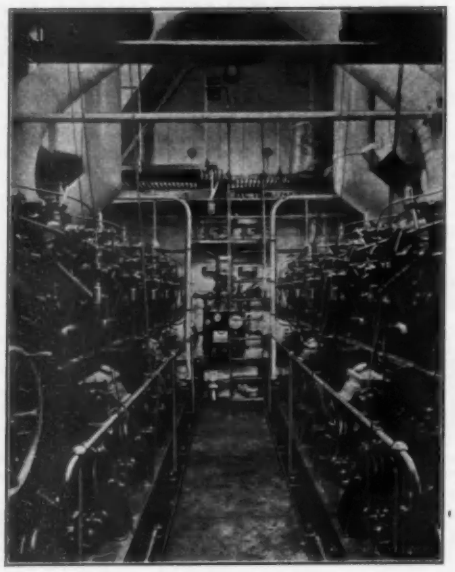
JOHN I. THORNYCROFT AND CO., LTD., SOUTHAMPTON, ENGINEERS



The Motor Yacht "Rosa."

On Saturday, August 31st, at the invitation of John I. Thornycroft and Co., Ltd., of London and Southampton, we inspected the twin-screw motor yacht "Rosa," which was recently completed at the firm's Woolston works for Count Ramon Godo, of Barcelona. The order for this yacht was secured, we understand, in the face of severe continental competition. As will be seen from the photograph reproduced above, the ship, which has been constructed to Lloyd's highest 100 A1 classification, has pleasing lines. The "Rosa" has been specially designed for cruising in warm climates.

The principal dimensions of the vessel are as follows:—Length between perpendiculars, 148ft.; breadth moulded, 25ft.; depth moulded, 14ft. 3in.; extreme draught, 11ft. 6in. The approximate Thames measurement is 400 tons. There is a flush deck right fore and aft, with a spacious promenade deck running well aft. All the public



FORWARD VIEW IN ENGINE ROOM

rooms are on the deck, and particular attention has been paid to their ventilation, in conjunction with the large vestibule and the passages connecting the fore and aft accommodation. At the forward end of the deck-house are the music room and the dining saloon, which extend to the full width of the ship. These rooms are separated by a panelled division with a centre archway. The music saloon, which at the forward end is provided with an enclosed altar, has a width of 23ft., with a length of 11ft. 6in., while the dining saloon is a roomy compartment of 22ft. in width, with a length of 13ft. 6in. Both these rooms open on to a vestibule, out of which runs a stairway to the owner's quarters below, and a passage at deck level alongside the engine-room casing to the smoking-room aft and the stairway leading to after cabins and state rooms. The owner's accommodation is forward of the engine-room on the lower deck, and comprises a sitting-room with a sleeping cabin and private bathroom. On the starboard side of the ship there also are two guests' state rooms and a bathroom. The after accommodation includes three further state rooms with bathroom and lavatory accommodation, and these rooms are entered from convenient lobbies. The whole of the decorations, the furniture, and the upholstering has been designed and fitted by the builders in simple schemes of eighteenth century English style, and is of a very high order. The officers and the crew are berthed forward, cabins, bathroom and a mess room being provided. The gallery and pantry are situated at the aft end of the engine-room casing.

The auxiliary machinery includes a Thermotank "Punkah Louvre" ventilation system, with two fan units, ventilation being fitted in all the public rooms and cabins. The principal apartments are provided with a supply of both hot and cold water, and a mechanical filter for drinking water is fitted. Refrigerating plant of the electrically driven CO_2 type, by West-Beynon and Co., is installed in the engine-room.

The propelling machinery comprises two six-cylinder cold-starting engines of Gardner manufacture, each of which has a designed output of 300 B.H.P., at a normal speed of 290 r.p.m. A view of the engine-room looking forward is reproduced herewith. During the short voyage we made in the Solent, the machinery ran very smoothly. On the official trials, which were carried out in Stokes Bay, a mean speed of 13·3 knots was obtained on the measured mile, which figure is well in excess of the contract speed. The yacht has been particularly designed for long cruises, and the fuel oil, lubricating oil, and fresh water tanks are of large capacity, and are carried in the double bottom. The supply of fuel oil carried is sufficient for a cruising radius of about 250 miles. The deck and engine-room auxiliary machinery of the "Rosa" is mostly electrically driven, and it comprises a Brown Bros. steering gear with telemotor control from the bridge; also an electrically-driven capstan and windlass by T. Reid and Co., Ltd., of Paisley. The power for the lighting and motor current also for the 12in. searchlight is provided by an 18 kW Gardner oil engine-driven generator set placed in the engine-room. On the promenade deck of the ship there are three boats which include a 23ft. open launch propelled by a Thornycroft motor, an 18ft. cutter, fitted with air tanks, and a 12ft. dinghy. Both in her design and appointments the "Rosa" is a fine example of a modern motor yacht.

American Engineering News.

Draught Gear for Goods Wagons.

Need for further improvement of the draught gear or drawbar attachment of goods wagons was discussed at the annual meeting of the mechanical division of the American Railway Association. The function of this attachment is to absorb the maximum buffing shock or traction pull with minimum reaction of the gear and minimum pressure on the wagon sills to which the gear is attached. One very important point to be attained is delay in the transmission of the blow to the wagon framing. With the early coil spring arrangement there was practically no time interval. The friction type of draught gear was then developed to attain these points, among others:—First, to increase the capacity of the gear beyond that of the spring gear; and second, to absorb more shock than the spring gear could absorb. This absorption is proportionate to the time occupied in closure and to the length of the travel. With the present travel of about 3in. the draught gear cannot adequately protect loaded cars with 70 and 100-ton loads. With about 4½in. of travel, it is estimated that the protection will be increased fourfold. As a matter of fact, there may be 9in. of slack due to wear and distortion, and it will be well to have part of this in the travel of the draught gear instead of being simply waste or lost motion. One trouble is the limited space provided, this being usually the same as provided for the old spring gear, so that the designer is handicapped. It is considered that the mechanical engineers and the draught-gear makers should discuss this problem together and design an underframe that will admit a friction draught gear of adequate capacity to meet the present conditions.

Concrete-steel Pipe Aqueduct.

Ten miles of aqueduct composed of 4ft. and 4½ft. concrete pipe will deliver water to a group of cities on San Francisco Bay, this new supply being brought from distant sources on the east side of the coast range of mountains by means of a tunnel through the range. The pipe-line aqueduct is designed for a test pressure of 130 lb. Each pipe, 12ft. long, has a core consisting of welded steel shell or cylinder, with a joint ring or flange welded on each end. Around this is placed a spiral coil of reinforcing steel, while on the inside is a cylinder of wire netting. The inner and outer lining of concrete protects the steel, gives a smooth surface for flow of water, and provides compressive strength to take the stresses of outside loading. The joints are connected and finished by men inside the pipe, a special form of locking joint being used. At one point on the aqueduct there is a tunnel about 1000ft. long. After the pipe was laid through this tunnel, the space surrounding it was filled solid with concrete by means of a compressed air "gun." Much of this pipe was laid in country roads and in narrow busy streets of towns, where the material excavated from the trench had to be hauled away at once by motor trucks. However, earth suitable for backfilling was carried back along the trench by the trucks and deposited over the pipe already laid, where it was packed by means of pneumatic tampers or rammers. This did not interfere with the joint work, as this was done entirely inside the pipe. Connections for manholes and blow-offs are welded to the steel pipe core.

Mechanically Puddled Wrought Iron.

A plant is now in operation producing 200 tons of wrought iron daily by a puddling process which eliminates the heavy work and high labour cost of manual puddling. A second plant now being built has a capacity of 600 tons, with provision for doubling that capacity. In the present works, pig iron is melted in a cupola of 12ft. diameter, having a melting capacity of 15 tons a week. It is charged mechanically and will run for about a week before patching at the tuyeres is necessary. An overhead crane carries a ladle of the molten iron to the converter house, which has two 2-ton side-blown acid-lined Bessemer converters in which it is refined. Slag of the composition needed is prepared by melting in a 20-ton oil-heated, tilting regenerative open-hearth furnace, with magnesite lining and water-cooled hearth. Melted slag about 3ft. deep is poured into a cup 3ft. by 4ft. and 5ft. deep, and about half the contents of the 5000 lb. ladle of iron is poured into the cup in about three minutes. Agitation or boiling takes place, but ceases with the pouring. The cup is picked up by the crane and excess slag poured into a second cup, which then receives the remainder of the iron charge. The first cup then contains a solidified spongy mass of metal intermingled with liquid slag and equal to the best product of manual puddling. This ball or block is dumped upon a travelling table and delivered to a manipulating hydraulic press, which makes it into a bloom 12in. by 14in. and 5ft. long. This goes to a 29in. three-high blooming mill, and then a 24in. three-high rolling mill, which produces billets and muck bars.

Hot-blast Foundry Cupolas.

Among the numerous developments for higher economy and increased output of automobile manufactories is the use of hot-blast for the cupolas of a new foundry specialising in gray-iron castings for automobiles, with a melting capacity of 400 tons daily. There are four cupolas with an inside diameter of 5ft. and a shell of 7½ft. Two of these are equipped for hot blast. From each of these two cupolas the combustion gases are drawn off through a series of openings about 5ft. below the charging door by means of a fan having about ½ oz. suction pressure. From the collecting chamber this gas—which is mainly carbon monoxide—is delivered to the combustion chamber of a heater serving the two cupolas. Into the blast heater the cold air is delivered and escapes from it to the cupolas at 400 deg. Fah. and about 8 oz. pressure. The temperature is maintained uniformly, and the volume of air delivered to each cupola is regulated automatically. Each of these two hot-blast cupolas has an output of 19 tons to 20 tons per hour, with a coke consumption of 1 ton per 10 tons of iron melted. Each cold blast cupola, of the same size, has an output of 15 to 16 tons per hour, with a ton of coke to 7 tons of iron. Longer life of the cupola lining is expected from the hot-blast cupolas. The charge of 4000 lb. consists of about 46 per cent. malleable pig iron, 35 per cent. cast scrap, 5 per cent. nickel-chrome iron, and 14 per cent. steel scrap. For a softer iron, ferro-silicon is added in the ladle. All the cupolas deliver to a 4-ton filling mixer on an electric lorry, which carries the iron to a hot-metal carrier with a 2000-ton ladle, which runs to the pouring floor and feeds the pouring ladles.

Lubrication of Locomotives.

A recommendation that modern locomotives should be equipped with the pressure system of lubrication, and that the cost incurred would be quickly repaid by the reduced amount of wear has been made by the mechanical section of the American Railway Association. On one road which has 350 engines thus fitted, an engine which had run 106,900 miles since the system was applied was found to require renewal of only one bushing in the valve gear and one pin in the spring rigging. The conditioning of a large goods engine equipped with this system required only 34 minutes and 3½ lb. of grease. The grease machine with air-hose attached was at the side of the engine, and grease was applied at 182 points. Mechanical lubricators are in extensive use and prove more reliable and efficient than hand lubrication. A recent development is an atomiser which mixes steam with the oil after it leaves the lubricator. This is found to give a substantial increase in the miles run per pound of oil. For coupling rod bearings, the use of floating bushings has largely superseded the ordinary brasses. The bushing may have a slip fit on the pin or a diameter $^1/_{64}$in. larger than the pin, and its outside diameter $^1/_{64}$in. or $^1/_{32}$in. smaller than the fixed iron bushing, although some roads omit the fixed iron bushing and make the floating bushing a slip fit in the rod. Grease for the cups on the rods is sometimes cut into slices ¼in. thick, which are dropped directly into the cups, thus preventing the entrance of foreign matter. The drivers carry a supply of them in cardboard tubes. Some railroads have applied a pressure system, but its only advantage appears to be the saving in time for oiling.

Some coal seams have been discovered in an escarpment near the Loangwa concession in Northern Rhodesia, and arrangements are being made for their development.

The Model Engineering Exhibition.

THE Exhibition organised by Mr. Percival Marshall, of the *Model Engineer*, which opened at the old Royal Horticultural Hall, Westminster, on September 11th, and closes to-morrow, is the eleventh to be held, and fully occupies all the space available in the Hall. It is naturally very similar to previous shows, but it struck us that there is a slightly smaller proportion of tools and small machines on view, while there has been an increase in the models shown, of both professional and amateur make. There is also a distinct increase in the representation of model clubs, and it was on the stands of these societies that we had some of the most interesting conversations during a brief visit to the Exhibition. The enthusiasm of the representatives of these clubs, who give up their time to attend the show, and answer the questions of casual visitors, is most refreshing after the apparent indifference one so often experiences at the stands of large engineering firms at other exhibitions. This enthusiasm, it seems to us, is a good indication that the educational side of the Exhibition, and the movement which it represents, is bearing fruit, for a man cannot be enthusiastic about anything which he does not understand. And in this connection some of the models shown are most interesting, as they give evidence that the maker has "found out" for himself as the work progressed. Take, for instance, a very neat little petrol engine. It is true to scale in everything of a mechanical nature, but it was found, when it came to the electrical ignition parts, that they could not follow the same scale. The voltage could not be scaled down, and consequently the insulation had to be as substantial as in a full sized engine. On the other hand, high pressures can be carried, as the mechanical parts are strong for their size.

The loan section of the Exhibition is fully as interesting as usual, and shows from what a wide field model makers come, and the diversity of their ages. Some are only apprentices, while the veteran, Mr. G. F. G. Desvignes, who is eighty-one years old, is showing a new model. In this section we noticed an exhibit of a really excellent educational value. It is catalogued as an Album of Knotting, and is far in advance of the usual sketches given in handbooks which attempt to give instruction in knotting. This album takes the form of stiff boards, on which there are tacked pieces of cord showing the knots in the process of formation so clearly that almost anyone should quickly learn the art. A bowline in a bight, which is generally a puzzle to the uninitiated, becomes quite simple as shown in the album.

Of the trade exhibits of tools, lathes, &c., we will not say much, as they closely resemble those of previous shows; but it is noteworthy that there is a distinct tendency to discard the flimsy affairs which were once considered good enough for amateurs, and that the modern tools are real engineering jobs. Also there is sound engineering work in the display of the R.A.F. (Aircraft Apprentices' Department). The exercises in fitting done by the apprentices in their first year would do credit to a journeyman fitter in many a tool-room. The large proportion of grown-up visitors, among whom we noticed several eminent engineers, is indicative that model making is not merely a game, but is an instructive recreation, which also has its social side.

LAUNCHES AND TRIAL TRIPS.

KUFRA, motor cargo vessel; built by Harland and Wolff, Ltd., to the order of the Moss Line, Ltd.; dimensions, 330ft. by 47ft. by 30ft. 3in.; 2650 gross tonnage. Engines, single-acting, four-stroke cycle; constructed by J. G. Kincaid and Co., Ltd.; launch, August 21st.

ATHELTARN, single-screw steamer; built by Cammell Laird and Co., Ltd., to the order of the British Molasses Company, Ltd.; dimensions, 220ft. by 36ft. by 14ft. Engines, inverted cylinder, triple-expansion, condensing; pressure, 180 lb.; constructed by the builders; launch, August 22nd.

CIUDAD DE ASUNCION, triple-screw motor vessel; built by A. and J. Inglis, Ltd., to the order of the Argentine Navigation Company, Ltd.; dimensions, 320ft. by 58ft. 6in. by 27ft. Engines, three sets of six-cylinder, single-acting trunk type airless-injection engines; constructed by Harland and Wolff, Ltd.; launch, August 22nd.

ILO No. 1, oil-engined tug; built by James Pollock, Sons and Co., Ltd.; dimensions, 64ft. by 14ft. 6in. by 6ft.; to carry oil. Engines, 50 B.H.P. two-cylinder Bolinder directly reversible heavy-oil engine; delivered, recently.

VILLANGER, twin-screw motor cargo vessel; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of Messrs. Westfal Larsen and Co. A/S., Bergen; dimensions, 415ft. by 54ft. 6in. Oil engines, constructed by J. G. Kincaid and Co.; trial trip, August 23rd.

PRINCE RUPERT CITY, steamship; built by Wm. Gray and Co., Ltd., to the order of Sir William Reardon Smith and Sons, Ltd., Cardiff; dimensions, 400ft. by 54ft. 3in. by 28ft. 0¼in.; to carry cargo. Engines, triple-expansion, 25in., 42in., 70in. by 48in. stroke, pressure 200 lb. per square inch; constructed by Central Marine Engine Works of the builders; trial trip, August 29th.

HANS RENOLD, LTD.—It is hard to realise that Hans Renold's has been in existence for fifty years, yet such is the fact. The founder, who was born at Aarau, Switzerland, came to England in 1873, when he was twenty-one years of age. Those were the days when young men plunged into business, and four years later Hans Renold became partner in a machine export business. In 1879 he bought for £300 a chain-making business in Salford, and laid the foundation of the present great organisation. Two years later he became a British subject. In 1880 he patented the bush roller type of chain which made the Starley safety bicycle a mechanical success. The old works proved adequate for only a few months, and in 1890 the building of a factory in Brook-street, Manchester, was begun, but it, in its turn, despite enlargements, had to be superseded, and a much bigger site was acquired at Burnage, Didsbury, where the factory now stands. Throughout the whole period not only did invention after invention for the improvement of chains appear, but advanced methods of manufacturing them and of shop management and organisation were introduced. The company now gives employment to 2250 people, and we are glad to say that the veteran founder, who is now in his seventy-seventh year, can look proudly upon the establishment of a business of which his adopted country is proud.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Slow Progress.

PROGRESS is being made in the iron and steel and engineering industries of the Midlands and Staffordshire, but it is slow. More orders are coming on to the market, and the tone is brighter. Tonnages continue light, however, and though the total material ordered or purchased is substantial, producers report that business is patchy. Signs of the development of trade are none too clear, but industrialists hereabouts continue to express their conviction that a re-invigoration of the market in the very near future is certain.

Raw Iron.

There has been no change in pig iron during the week, though the chief interest in the market continues to be centred in this commodity. Many contracts will run out this month, and consumers who approach blast-furnacemen regarding renewals are being "put off" for the time being. Furnacemen are becoming somewhat alarmed regarding the coke position, and foresee the necessity for putting up their prices to compensate for the higher costs of production. They are paying as much as 16s. 6d. per ton at ovens for furnace coke, and there seems little prospect of any relief. As the autumn develops, there will be a heavier demand on the smaller coals used for heating apparatus, and the tendency will be towards higher fuel values. Blast-furnacemen in the Midlands point out that while under the auspices of the Central Pig Iron Producers' Association selling prices of pig iron have advanced some 5s. to 7s. per ton, blast-furnace coke has advanced 4s. per ton. As it takes about 1½ tons of coke to smelt a ton of pig iron, they are really little if anything to the good. Many of them under these circumstances consider that they should obtain better prices on new long date contracts as a protection against contingencies which may possibly arise in the industry. The recent decision of the Pig Iron Association to leave prices as at present for the time being, does not affect the view of many smelters that the time has come for another rise in prices. It is recognised that the price fixed is a minimum, and that when demand warrants it, there is nothing to prevent smelters asking for premiums on the fixed Association basis, as they have done previously with success. At date supply and demand appear to be about equal, despite the accumulation at the furnaces during the August holidays. Smelters with the slack season practically over can afford to hold some stocks against the autumn re-invigoration of demand. Specifications are coming in regularly against contracts, and orders for supplies for current consumption are in the market. Fairly substantial tonnages are changing hands, and for the most part at the following price:—Northamptonshire forge, £3 8s. 6d.; No. 3 foundry, £3 12s. 6d.; Derbyshire forge, £3 12s.; foundry, £3 16s. per ton, delivered at Black Country stations.

Increased Call for Steel.

The demand for structural steel continues to make headway, the improvement noted in this letter last week having been more than maintained. Some of the Midland constructional engineering firms are reported to be fully occupied, but it is admitted that much of the work relates to small contracts. Nevertheless most local firms have of late added to their order books, and the aggregate represents a considerable amount. An improving business is accordingly being done in joists, sections and plates, prices of which remain unchanged at £8 2s. 6d. for joists and sections and £8 17s. 6d. for plates, all subject to the usual rebate in the case of firms agreeing to use British steel only. Now that there are prospects of a larger consumptive demand it is hoped by users that the present level of prices will be maintained. Boiler plates are in regular demand at £9 12s. 6d. per ton, Black Country works having reasonably good orders to keep them employed. In the half-products branch a lowering of continental selling prices has intensified competition, but manufacturers hereabouts are not inclined to buy on a falling market, and are consequently placing little business abroad. Birmingham merchants continue to cut prices in an endeavour to secure orders, but they do not appear to be meeting with a very large measure of success. Foreign 2in. billets are freely offered at £5 15s. delivered, and steel bars at £6 15s. Some Welsh mills have been endeavouring to obtain higher prices for sheet bars, and although quotations have been in the region of £6 10s., business has still been transacted at £6 5s. and £6 7s. 6d. Re-rollers in Staffordshire quote small steel bars £8 5s. upwards. Steel-masters on 'Change in Birmingham this week complained of delay in delivery of steel from the north. A shortage of the special trucks necessary for the transport of heavy steel is held to be responsible.

Finished Iron.

The finished iron trade in Staffordshire changes hardly at all, the improvement in consumptive demand being so gradual as to be barely discernible week by week, though it is noticeable month by month. A steady demand for marked bars is a feature of the market. Values of these bars remain unchanged at £12 per ton, but production costs have risen so much of late that a revision of finished iron prices would not occasion surprise. Ironmasters have fairly good order books, and there are evidences of a growing demand for best class bars for exacting engineering requirements. The autumn is expected to add materially to Staffordshire ironmasters' order books, and producers are loth to take any action which might prejudice this anticipated business. Staffordshire grade Crown bars sell moderately at £10 to £10 5s. They have to compete with bars from other districts which are quoted in some cases as low as £9 15s. per ton. Producers in this district complain that present selling prices are unremunerative. There is only a fair call for nut and bolt and fencing bars at date. The Darlaston and district bolt and nut works are not so well placed for work as they were, and there is some unemployment in the trade. Common bars are quoted £9 upward, but the difficulty of selling against Belgian No. 3 iron, used for similar purposes, obtainable at £6 15s. per ton delivered here, will be readily recognised. There is little doubt but that the bulk of the raw material used in the Black Country bolt and nut works is of foreign origin. Wrought iron tube strip continues in excellent request, and consumers are paying the half-crown advance in prices recently asked for by sellers. Very little material, if any, is now obtainable at £11, quotations generally of £11 2s. 6d. being rigidly adhered to.

Improved Sheet Demand.

This week has witnessed some small revival in demand for galvanised sheets, but rollers still await instructions from the chief overseas buyers. The business which has come to hand so far is chiefly on account of South Africa and is in the nature of "rush" orders. The bulk of the trade done is on the basis of £13 7s. 6d. f.o.b. for 24-gauge corrugated sheets, but some mills continue to ask £13 10s. upwards. Black sheets continue relatively quiet at recent selling rates.

Steel Scrap.

Birmingham merchants attribute the falling off in demand for steel scrap partly to the slowing down at some Welsh steel works and also to an increased supply of basic pig iron. There is now no pressure upon supplies, and prices vary between £3 16s. and £3 17s. 6d. delivered South Wales. Sellers express the belief that demand will become more active in the near future.

Rebuilding of Railway and Canal Bridges.

The Walsall Town Council has just approved a scheme of canal and railway bridge rebuilding and road improvements to be carried out within the next five years, at an estimated total cost of £115,298, of which it is expected £69,431 will be borne by the Ministry of Transport. It is considered that the reconstruction of the bridges is an urgent matter while the road improvements are desirable. One member of the Council has urged the use of steel girders in the bridge reconstruction, pointing out that the steel industry needs help at the present time.

Unemployment.

Despite the fact that unemployment in the Midlands area shows a decrease of 3484 on the week, the Birmingham and Black Country districts do not make a good showing. Indeed, increases of varying magnitude are recorded at Birmingham, West Bromwich, Smethwick, Wolverhampton, Dudley, Bilston, Cradley Heath and Redditch. The increase in Wolverhampton, which amounts to nearly 1000, is attributed to quietness in the motor car and edge tool industries. At Nottingham, Leicester, Northampton, and in the Stoke-on-Trent area unemployment is declining.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Locomotives and the Argentine.

LANCASHIRE engineers and the heavy industries generally expect to benefit materially from the agreement which, as was announced by the Foreign Office early this week, has been provisionally entered into by the British Mission to the Argentine with the Government of that country for the purchase of British manufactures to the value of about £8,000,000 during the next two years. Exactly to what extent they will benefit is, however, a question for the future. The point of view of the locomotive-building industry was expressed this week in the course of a Press interview granted by a representative of Beyer, Peacock and Co., Gorton, Manchester, who do a good deal of work for South American countries. The British-owned railways in Argentina, he said, have always placed their orders for locomotives in Great Britain, so that as far as these are concerned there will be no change of policy. There are certain railways, however, which are owned by the State, and it is possible that the British Mission might have made some deal with them. Those railways place their orders for locomotives and other material anywhere—some in the United States, some with continental countries, and some in Great Britain.

Industrial Conditions.

In the course of its monthly survey of general industrial conditions, the Manchester Chamber of Commerce reviews the position in the engineering trade as follows:—A substantial part of the engineering trade is fairly well employed and parts of it are really busy. Some firms, however, are in need of additional orders. A good many railway contracts for overseas have been given out. Textile machinists have had a number of orders from the Continent, including Russia, and one big concern has been actively engaged on spinning machinery for Lancashire mills. Home contracts, however, have been scarce, and seem likely to be scarce for some time, unless the new combines are able to replace part of the machinery they are taking over. Electrical engineers, and particularly makers of heavy generating plant, have been well engaged; constructional engineers have had big contracts in hand, and makers of motor cars and commercial vehicles have been fairly busy. Machine tools have continued in good demand and the same may be said, broadly speaking, of cranes and gas plant.

Dutch Cable for Salford.

As on a number of occasions during the past few years, a decision of the Salford Electricity Committee to purchase cable from a Dutch concern—the Nederlandsche Kabelfabriek, of Delft—although severely criticised, was

ratified by the City Council at its last meeting. The chairman of the Committee said that the tender they had decided to accept, amounting to £8428, was 14 per cent. lower than the lowest satisfactory British tender. It was stated during the discussion that by accepting tenders from the Dutch firm the City Council had been able to effect a saving of more than £10,000. As the money had to be borrowed, there had, it was pointed out, been a corresponding saving in interest and loan charges, making a total saving to the ratepayers of at least £20,000. In moving an amendment to substitute the lowest satisfactory British tender, the mover said that the City Council had never faced the unequal factors that existed in the competition that had to be met from foreign firms.

Appointment of Gas Engineer.

The Manchester City Council at its last meeting approved the minutes of the General Purposes Committee which contained a resolution referring back for the further consideration of the Gas Committee a recommendation that Mr. A. L. Holton should be appointed to the position of chief gas engineer at a commencing salary of £1750 a year.

Liverpool's Schemes.

The Liverpool City Council has decided to put in hand a number of unemployment relief schemes at a total cost of nearly £2,500,000. One of them provides for the construction of a road tunnel, at a cost of £750,000, to link up the new Mersey Tunnel running between Liverpool and Birkenhead with the East Lancashire road now in course of construction and for the conversion of the road into a tram route. The sum of £10,000 has been allocated to the preparation of a site for a municipal aerodrome. For the best two competitive designs submitted by architects for a scheme to improve the whole amenities of the Pier Head at Liverpool, the City Council has decided to offer premiums of 1000 and 500 guineas.

The Pennine Railway Proposal.

In connection with the scheme to construct a new 6-mile railway from Stalybridge to a point between Hadfield and Crowden on the London and North-Eastern main line from Manchester to London, referred to in this column last week, a trust company has been formed with a nominal capital of £3000 under the title of the Pennine Railway Trust, Ltd., with registered offices at Victoria Buildings, Deansgate, Manchester. Application is to be made for a Government grant for the construction of the railway, the estimated cost of which is about £400,000.

Non-ferrous Metals.

Although on balance there is very little difference between current values of non-ferrous metals generally compared with those ruling a week ago, experience in certain sections of the market has by no means been so placid as a bare comparison of the past week's opening and closing quotations would lead one to assume. In the case of copper, the turnover has been heavier than for some considerable time, but the bulk of it was on speculative account. Current values of standard metal at the time of writing are a matter of 1s. a ton higher for cash than they were a week ago, although fully £3 a ton below the highest point touched during the past week. The rise and the fall were due almost wholly to speculative transactions, and, in a way, were reminiscent of the movements recorded during the "ramp" early in the year. There has been a moderate buying movement in the tin market, but here also much of it has been of a professional nature, both the "bears" and the "bulls" in turn having their innings. At the moment the position seems to be barely steady, with values down roughly to the extent of about 5s. a ton on the week. There has been some reaction in lead after the previous week's rather sharp rise, but prices are still higher than they were a fortnight ago, and domestic users have been operating fairly freely. Spelter also has attracted rather more attention, and there has been a slight recovery.

Iron and Steel.

Foundry iron is distinctly firm on this market and deliveries to local consumers against contracts during the past week or so have, if anything, been better than they have been of late, and this points to a further steady improvement at the consuming end of the trade. So far, however, there has been nothing resembling the beginning of a "wave" of autumn buying, though this is likely to develop soon, for there is little in the way of easier price prospects to hold buyers back. Quotations are extremely firm at 74s. 6d. per ton for Derbyshire and 75s. 6d. for Staffordshire, both for delivery in the Manchester price zone, with Scottish well held at 92s. 6d. to 93s. 6d., and hematite at about 87s. 6d., delivered here. The usual moderate business is being done in manufactured iron, with Lancashire Crown bars at £10 15s. per ton and No. 2 quality at £9 15s. Constructional engineers are now taking fair aggregate quantities of steel, locomotive builders are specifying freely, and, on the whole, there is a good demand from general engineers. Most of the current business, however, is against orders already placed, for only a moderate weight of new business has been booked here during the week. All-round firmness continues in evidence, and there is no change to report compared with prices ruling of late. Foreign semi-finished and finished steel has shown some easiness, but the demand locally is again subdued after one or two short-lived spurts.

BARROW-IN-FURNESS.

Hematite.

The hematite iron trade continues to be healthy in tone and makers are having no difficulty in clearing their output, despite a very pronounced falling off in the requirements on steel account. Orders are held which will keep some of the producers busy well into next year. There is one unfortunate feature from the smelters' point of view, and that is the price which obtains at present. It certainly leaves little margin and there is a desire to increase it, but it is feared that such an action would operate against business, and result in a considerable falling off in orders. The business with the Continent is maintained, as also is that with America, but the prices obtained from the latter business are inclined to be so thin as to permit of little profit. Special qualities continue to be in good demand. The iron ore trade is very steady and the outside demand is satisfactory and showing signs of further improvement. Foreign ore is in steady demand. The steel trade is in a poor way, and it is a long time since the market was so dull. There are some who hope that something will come of the new agreement with Argentina, but it is too soon to count on anything tangible from that direction as yet. Hoops are in steady demand, mostly on overseas account.

SHEFFIELD.

(From our own Correspondent.)

Conditions in the Steel Trade.

THERE is little alteration to report in the state of the various branches of the steel trade carried on in this district, but optimism as to the future continues, and such signs as there are support that view. The steady demand for raw materials indicates a feeling of confidence, and there is a strength in the market which, it is thought, may result in increased prices before long. The basic steel furnaces are still well employed, and there is much activity in various special departments. The requirements of the automobile industry are maintained at a high level. These consist of parts and special steels for the machinery of the cars and a good tonnage is going regularly to the builders. The wire and wire rope trades show an improvement on the early part of the year. The acid side of the heavy trade is still in an unsatisfactory condition, largely owing to the shortage of railway work, which the British companies are still giving out on a very small scale.

A Growing Industry.

One of the most progressive sections of the heavy steel trade is the manufacture of hollow-forged drums. Until comparatively recently, these drums were produced by only one plant in Sheffield, and they were used largely as turbine drums for battleships. The demand has been increased by the development of high-pressure steam and the knowledge that the drums can be used in schemes of testing aircraft. There are now two works which specialise in this class of manufacture, and the orders at present on hand are stated to be of an aggregate value running into six figures.

Railway Work.

There is good news for Sheffield in the announcement of a provisional agreement which has been arrived at as the result of the visit of the British Economic Mission to Argentina. The object of the agreement is to make provision for the purchase during the next two years of British manufactures to the extent of approximately £8,000,000 required by the Argentine Government for their railways and public works, in return for the purchase through trade channels of Argentine food products to a similar value. As Sheffield is one of the principal centres in the country for the production of railway material, it stands to benefit very materially from this arrangement. The city already sends railway supplies to the Argentine, but in recent years it has suffered greatly from foreign competition, and therefore a definite agreement of the sort referred to should be of great assistance. The placing of several railway orders has been reported during the past week, but the only one in which Sheffield is concerned relates to the supply of steel boiler tubes to the Egyptian State Railways, which has been divided between Howell and Co., Ltd., of this city, and a Swedish firm. Inquiries are afoot for railway material for India. The India Store Department is requiring 188½ tons of 60 lb. rails treated by the Sandberg Sorbitic process, and 95 tons of fish bolts and chair bolts. The South Indian Railway is in the market for four-wheeled steel ballast wagons, pressed steel sleepers, water cranes and hand-power ram pumps and the same company requires, for its Madras suburban services electrification scheme, converter equipment for sub-stations, transformer switchgear and accessories, overhead transmission line and car shed structural steelwork. The Bombay, Baroda and Central Indian Railway is inquiring for girder bridges.

Work for Russia.

Rumour was busy a few days ago, coupling the name of Vickers, Ltd., with that of Russia, and giving the firm credit for being in negotiation with the Soviet Government for a specific contract to the value of £15,000,000. Messrs. Vickers officially announced that the statement was incorrect. The English Steel Corporation, of which Messrs. Vickers form a part, admitted that certain contracts with Russia were being arranged, but the amount involved was £1,500,000, a substantial sum, but only one-tenth of that which had been currently reported.

A Cement Plant.

The Sheffield firm of Edgar Allen and Co., Ltd., who specialise in the manufacture of cement plants, have recently completed another contract for a modern plant for manufacturing high quality Portland cement. The plant was supplied to the Chinnor Cement and Lime Company, Oxfordshire. It replaces a smaller plant which was started in 1921, consisting of a battery of improved type chamber kilns, and which included Edgar Allen machinery for the preparation of raw materials in the grinding of cement clinker. Edgar Allen and Co. announce that they will shortly open a branch in Detroit, U.S.A.

Derwent Valley Water.

My reference last week to the completion of the second instalment of the works of the Derwent Valley Water Board may now be supplemented by a detailed description of this new portion of a great undertaking. It has consisted of the diversion of the Ashop and Alport rivers into the Derwent reservoir, and the laying of an additional line of pipes from Derwent reservoir to the filters at Bamford. In order to divert the two streams, low weirs, 12ft. and 6ft. high, have been constructed, consisting largely of reinforced concrete. The water from the Alport Valley is taken through a short tunnel and watercourse 3ft. 6in. wide to the upstream side of the Ashop Weir, which is designed to have a long length of overflow so as to discharge floods unduly raising the level of the water in the river. At the southerly end of this weir the water enters a watercourse, 2422 yards long, down the Ashop Valley, and, after passing along this channel, it enters a line of concrete-lined steel pipes, 6ft. in diameter, and is conveyed across the valley to the mouth of a tunnel through the hill between the Ashop and Derwent valleys. The tunnel is 1055 yards long, and from its northerly end a watercourse carries the water into the Derwent reservoir. The added drainage area is 10,323 acres. In order to convey the water to the new filter station at Bamford, it has been necessary to lay 10,000 yards of concrete-lined steel pipes 45in. in diameter. Second lines of pipes are also being laid on several of the syphons between Bamford and Ambergate. The increase in town supply, due to this second instalment of waterworks, is 6,630,000 gallons per day.

Barnsley Schemes.

A large programme of works for the relief of unemployment has been drawn up by Barnsley Town Council, which has decided to submit to the Unemployment Grants Committee schemes representing a total expenditure of £96,029. One of the principal schemes is the construction of a new ring road between Keresforth Hill road and Dodworth-road, and between Dodworth-road and Farmhouse-lane, which will be part of the town planning ring road, and will be 60ft. wide. The estimated cost of this is £28,000, exclusive of land. The old Ingbirchworth water main from the borough to Champany Hill is to be relaid, at a cost of £14,000, and a new main from Champany Hill reservoir to Sheffield-road will call for an expenditure of £24,000. It is also proposed to change over the system of electricity supply from direct to alternating current in a number of streets, £10,890; to lay a new sewer at Hoyle Mill, £8500; and to carry out various smaller works.

NORTH OF ENGLAND.

(From our own Correspondent.)

Tees Shipbuilding Record.

A REMARKABLE achievement in shipbuilding and conversions has been accomplished by Smith's Dock Company, Ltd., South Bank. The firm has made a speciality of whaling vessels, and the summer programme, which is now virtually completed, comprised the conversion of two former liners into floating whaling factories, which left the Tees a few days ago, and the building of thirty-six "catchers," four of which are still to complete. It is a programme that has meant work for between 3500 and 4000 men during the whole of the summer. Originally belonging to the Royal Mail Steam Packet Company, the two liners referred to were the "Carmarthenshire" and the "Cardiganshire," and they have been converted into large whaling depôts, to the order of Chr. Salvesen and Co., of Leith. Their new names are now the "Sourabaya" and the "Salvestria" respectively. Both liners have been transformed completely for dealing with whales on the open sea. Perhaps the most interesting feature is that the stern has been cut away, and that a slipway rising from the water line at a convenient angle to the deck has been introduced. By this means a whale can be hauled bodily from the water on to the deck, special winches being used for the purpose. Oil-tight bulkheads have been fitted into the lower holds to enable the vessel to carry whale oil in these compartments, and special machinery has been installed inside for boiling and purifying the whale blubber. The "catchers" are tough little steel crafts which are manned by a crew of about a dozen men.

Cleveland Iron Trade.

As is usual when the dull season ends, a gradual movement towards normal market conditions has set in. The total volume of business passing just now is not large, but the aggregate tonnage output is heavy, and producers have contracts that will keep plant busy for some time. Autumn buying for home purposes promises to be on a considerable scale, and hope is expressed that overseas customers may be tempted to make more extensive use of Cleveland products. The present output of pig iron is immediately absorbed, and preparations are proceeding for enlargement of production. Of the ninety-five blast-furnaces on the North-East Coast forty-five are in operation. The furnaces at the Seaton Carew Ironworks have been inactive for a lengthy period, but two are expected to be rekindled by the end of this month or early in October. Buying is still chiefly for home purposes, but exporters are now taking some interest, though existing conditions are far from conducive to the development of overseas trade. No. 1 Cleveland foundry iron is firm at 75s.; No. 3 G.M.B., 72s. 6d.; No. 4 foundry, 71s. 6d.; and No. 4 forge, 71s.

Hematite Pig Iron.

The firmer feeling in the East Coast hematite pig iron trade is rather more than sustained, but producers complain that the upward movement of prices is at an unsatisfactory and disappointing rate. To reach economic level, they say, quite 4s. must be added to current quotations. Second hands are accepting 76s. for ordinary qualities, but producers are inclined to hold out for 76s. 6d. No. 1 grade of hematite is at a premium of 6d. per ton.

Ironmaking Materials.

Consumers of foreign ore are bought extensively ahead, but some apprehension is felt that tonnage scarcity

may again curtail deliveries. Quotations are nominal at the equivalent of best Rubio at 24s. 9d. c.i.f. Tees. Production of blast-furnace coke is being much enlarged, but requirements promise to be heavier, and some fear is expressed that increased output may not be adequate to needs. Scarcity of coke enables sellers to obtain high figures. For good medium kinds, delivered at North-East Coast works, 23s. is generally named, and in some cases more is asked.

Manufactured Iron and Steel.

Values of manufactured iron and steel are well maintained, though keener competition from continental sources is experienced in some departments. There is much activity at the steel works. Manufacturers of shipbuilding material are turning out heavy tonnage, and specifications for other descriptions are coming forward freely. Business in galvanised sheets is improving, but works could still handle a bigger tonnage. All prices are firm and unchanged.

The Coal Trade.

Poland has received a rather severe setback in the tussel between herself and Northumberland by the announcement that the Finnish State Railways have decided to place their order for 41,000 tons of steam coals to a large extent with Northumbrian and Yorkshire collieries. The order is for 7000 tons of best Northumberland steams at prices of between 23s. 9d. to 24s. 9d., according to the port of delivery; 15,000 tons of Northumberland steams of secondary grade on an f.o.b. basis of 14s. 9d.; and 15,000 tons Yorkshire steams on a c.i.f. basis, delivery ports being stipulated, of 24s. 1d. Poland has received but a small allocation, 5000 tons of best Polish steams at 15s. 6d. f.o.b. Danzig. Although buyers can secure all the prompt coal they desire just now, and in some instances are obtaining rather substantial discounts for prompt lots, prices on the whole remain unshaken, particularly for Northumberland grades, where, under a consistent demand and with a better supply of vessels, fitters are firmly asking current figures. The lack of tonnage is assuming graver aspects, especially for many of the collieries producing coking coal, bunkers, and the lower grades of gas fuel, and there is a likelihood of idle time if things do not quickly improve. Outputs will necessarily have to be reduced unless enough tonnage comes forward. Best Northumberland steams are quoted at from 15s. 9d. to 16s., and seconds at 14s. 6d. to 14s. 9d. Best Durham gas coals are finding a very good forward demand, but are plentiful for prompt at from 16s. 6d. to 17s. There are probably more second-class gas coals about than buyers can be found for—that is, for prompt—but they are steadily quoted at 15s. 6d. Durham coking coals can also satisfy immediate demands, but are wanted forward, and are quoted at unaltered figures at from 15s. 6d. to 16s. Demand for all classes of coke is at present in excess of the immediate supply, and manufacturers take a firm stand at 24s. for patent foundry, 28s. for beehive foundry, and about 32s. for special grades.

SCOTLAND.

(From our own Correspondent.)

Moderate Outlook.

WHILE the general trend of business in steel, iron and coal shows little actual change so far as turnover is concerned, the outlook may be termed moderate, and the present level of activities may continue unchanged for some time ahead. Reports from the shipyards are not particularly bright, but there are possibilities of improvement, with a consequent increase in demands for steel and the other commodities required. Orders for locomotives and structural steel have been more prolific of late. The iron market is rather a dull feature at present. Prospects in the coal trade are considered to have improved somewhat, but a decided increase in turnover will probably not be apparent until the scheme for the stabilisation of the industry, at present in the course of preparation, is announced. It may be said that on the whole there is a fair measure of optimism in trade circles generally, and the opinion seems to be that before the autumn is over some improvement will be noted.

Steel.

The demand for heavy steel is comparatively quiet at the moment, but producers are confident that a fair amount of business will be placed within a week or two. At present plates are not so well placed as sections. Steel sheets are still quieter than is usual at this period of the year, owing, it is said, to the saturated condition of the markets in the Far East and India. It is anticipated, however, that before this month is ended normal conditions may again be established. Steel tubes are busy and practically all the departments report a heavy output. This state of matters is likely to continue, as several good contracts have been booked quite recently. The demand for structural steel has also increased during the past week or two, and the position in certain producing areas has greatly improved accordingly.

Iron.

The position in the iron trade is not encouraging. Bar iron makers may be a shade busier than recently, but they have a long way to go before conditions are normal. The steel re-rolling departments, too, have slackened off somewhat, owing to the keen competition in overseas markets. Bar iron is unchanged in price, and re-rolled steel bars are still quoted in the region of £8 per ton home and £7 15s. per ton export.

Pig Iron.

There are twenty-seven furnaces in blast in Scotland at present, the output from which is being steadily disposed of at the prices fixed at the last agreement.

Scrap.

Scrap material is not too plentiful, and prices remain on a firm basis as follows:—Heavy steel, 76s. 3d.; cast iron machinery, 70s. per ton.

Coal.

So far as new business is concerned, the coal market continues quiet. Shipping inquiries are not extensive, but in any case exporters are not desirous meantime of contracting far ahead. Most of the collieries are fairly well booked up at present, and with outputs going away steadily against contracts have only moderate lots available for immediate disposal. These easily secure full market prices. All descriptions of round coal, and especially prime Fifeshire steams and Lanarkshire splints and ells, are firmly held. Washed nuts in all districts are a strong market, trebles being particularly firm. Aggregate shipments amounted to 301,157 tons, against 287,429 tons in the preceding week and 262,455 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

IMPROVEMENT which was expected in the demand for steam coals has not matured so far, and the result is that the position of collieries varies considerably, mainly consequent upon the shortage of prompt orders for large qualities. Shipments of coals from South Wales last week marked a reduction, as was not surprising in view of the fact that the docks were far from being well off for tonnage. On Saturday the number of idle tipping appliances was twenty-seven, and there were only eight steamers waiting to get into berth. Arrivals of tonnage over the week-end were fairly good, but on balance the position was not materially improved, for although fifteen steamers were waiting there were no less than twenty-six idle tipping appliances. Chartering keeps at a very moderate level, though it was active last week for South America, for which direction rates of freight had an abnormally sharp rise of about 5s. per ton, much to the discomfiture of charterers, and 18s. 6d. was paid for Buenos Aires, and 17s. for Rio de Janeiro. Since then the market has shown a tendency to relapse, but at the same time rates are far above what merchants have estimated upon for c.i.f. business, and substantial losses must be incurred in the execution of orders held by them. The current demand for coals continues to be comparatively meagre, and this applies at the moment both to supplies for prompt loading and to forward delivery. There appears to be a tendency generally to hold off buying, notwithstanding the fact that higher minimum prices come into operation from the beginning of October.

Italy and Coals.

Now that the official text of the agreement reached at the recent Hague Conference has been published, there appears to be a greater feeling of satisfaction with its provisions, particularly as regards the supply of coals to Italy. Apart from the additional million tons to be taken for three years, there is the fact that Italy has agreed not to take more than 1½ million tons of Reparation coals for the State Railways by sea, the balance of about 500,000 tons to be land-borne. This limitation of sea-borne coals is all to the advantage of this country. So far it is understood that nothing has been disclosed as to what arrangements will be made by Italy for the lifting of the additional million tons per annum, but a report has been current that it will eventually be found that a provision will be made for the coals to be shipped from this country by Italian vessels in preference to tonnage of other nationality. In pre-war days when shipments from South Wales for account of the Italian State Railways were very heavy, preference was given to Italian-owned vessels, subject to rates of freight being equal, but in the case of Reparation coals, it has been a condition of their delivery from Germany through Rotterdam that vessels of the Italian flag only should be employed. Whether this condition will be enforced in the case of the coals to be shipped from this country as from the end of this year remains to be seen.

Collieries Re-opening.

After being closed down for more than twelve months the Senghenydd Colliery is to be reopened. A visit was paid to the colliery on Monday by the chief officials of the Powell Duffryn Company, and it is understood that about 300 men are to be employed immediately, and there are expectations that this number will be increased to about 500 by Christmas. It is also understood that the colliery is to be electrically equipped on the most modern lines. At one time this colliery employed about 2500 men. Steps are being taken to bring about a resumption of work at the Naval Colliery, one of the four groups comprising the Cambrian Combine, purchased in July last by Sir D. R. Llewellyn, Bart., on behalf of Guest, Keen and Nettlefold's, Ltd., for £745,000. It is the intention to open up the working of the Pandy Pit, but as the colliery has been idle for twelve months, considerable repair and clearance work has to be effected. It is hoped, however, that several hundred men will be employed before the end of the year.

Current Business.

The market has been quite featureless so far as new business is concerned for early delivery. Large coals are in need of orders, and values continue to rule, for the most part, on the basis of minimum schedule prices. The steadiness of smalls and sized coals is well maintained. So far as can be ascertained, the only period inquiry on the market is for about 15,000 to 20,000 tons of steam coals for the M.Z.A. Railway of Spain for delivery over about three months at the end of this year. Meantime, it is understood that coalowners are pushing on with the details of the marketing scheme, involving price and output regulation. The draft of the scheme has been in the hands of the colliery companies for a week or so. Certain details have yet to be agreed. The outlet for coke continues to be very steady, and patent fuel makers are comfortably stemmed. Pitwood is easier, and is now round about 35s., with a tendency to weaken further. The strike of pitwood and other workers at Bordeaux last week did not last twenty-four hours, and supplies are coming forward better.

CATALOGUES.

STEEL, PEECH AND TOZER, Ltd., Sheffield.—An illustrated descriptive pamphlet on forgings.

BRITISH OXYGEN COMPANY, Ltd., Angel-road, N. 18.—"Hints on Oxygen Metal Cutting."

HOPKINSONS, Ltd., Huddersfield.—List No. 2130 of the "Hopkinson-Ferranti" steam stop valve.

STAVELEY COAL AND IRON COMPANY, Ltd., Chesterfield.—August stock list of cast iron pipe specials.

AVONSIDE ENGINE COMPANY, Ltd., Bristol.—An illustrated booklet on internal combustion locomotives.

RATEAU, 28, Russell-square, W.C. 1.—Catalogue No. 105, giving specifications of centrifugal pumps for small duties.

DAVEY, PAXMAN AND CO., Ltd., Aldwych House, Aldwych, W.C. 2.—Catalogue 951 of Paxman boilers and superheaters.

BLACKMAN EXPORT COMPANY, Ltd., 374, Euston-road, N.W. 1.—Particulars and prices of "Blackman" streamline propeller fans.

ENGLISH ELECTRIC COMPANY, Ltd., Queen's House, Kingsway, W.C. 2.—Publication No. K 27, "Bus Bodies and Trolley Buses."

WOODHALL-DUCKHAM COMPANIES, Allington House, Victoria-street, S.W. 1.—Brochure on the Peale-Davis system of dry cleaning coal.

NORTON COMPANY, Worcester, Mass., U.S.A.—A leaflet describing the "Norton" 24in. swing frame machine for high-speed snagging.

ATLAS METALS AND ALLOYS COMPANY, Ltd., 1, Central-buildings, S.W. 1.—A brochure stating the salient features of the firm's products.

CEMENT MARKETING COMPANY, Ltd., Portland House, Tothill-street, S.W. 1.—Giving particulars of "Snowcrete" white Portland cement.

SIEMENS BROTHERS AND COMPANY, Ltd., Woolwich, S.E. 18.—Catalogue 160, Section VI., giving specifications of various types of straight joint boxes.

MAWDSLEY'S, Ltd., Dursley, Glos.—A catalogue printed in English, French, German, Italian and Spanish, dealing with electric arc welding sets.

LEA RECORDER COMPANY, Ltd., 28, Deansgate, Manchester.—Book C.B.M. 13 of the Lea "Cubi-meter" for measuring coal and other materials in bulk.

BRITISH ALUMINIUM COMPANY, Ltd., Adelaide House, King William-street, E.C. 4.—Booklet 324, "Light Alloys in Aircraft;" 325, "Light Alloys in Industry."

VACUUM OIL COMPANY, Ltd., Caxton House, Westminster, S.W. 1.—No. 32 of the Gargoyle Technical Series, entitled "The Lubrication of Surface Ignition Oil Engines."

STURTEVANT ENGINEERING COMPANY, Ltd., 147, Queen Victoria-street, E.C. 4.—Publication 1130, illustrating a number of turbine vacuum cleaning plants in hotels, shops, theatres and public buildings; also Publication No. 1605 on laboratory machinery for crushing, screening and grinding.

CONTRACTS.

ALLOY WELDING PROCESSES, Ltd., of Forest-road, Walthamstow, London, E. 17, have secured a contract from the Admiralty covering the supply of A.W.P. electrodes during the period from July 1st, 1929, to June 30th, 1930.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

A-S REFRIGERATING MACHINES, Ltd., Magnet House, Kingsway, W.C. 2, has changed its telephone number from Regent 7050 to Temple Bar 8000.

THE telephone number of the General Electric Company, Ltd., Magnet House, Kingsway, W.C. 2, has been changed from Regent 7050 to Temple Bar 8000 (seventy lines).

NEWTON, CHAMBERS AND CO., Ltd., Thorncliffe Collieries, Ironworks and Chemical Works, near Sheffield, have appointed Major Richard Miles to manage the ironworks department, in succession to his father, the late Mr. T. V. Miles, director and general manager.

WITH the object of propagating a knowledge of modern welding processes amongst those who are likely to be interested, Alloy Welding Processes, Ltd., of Ferry-lane Works, Forest-road, London, E. 17, have established a house organ called the *Welder*, which was published for the first time on September 1st. Copies can be obtained on application to the firm.

GALLOWAYS LTD. wish it to be generally known that, although they have closed down their boiler works at Ardwick, extensions have been made to their engine works at Knott Mill and plant has been transferred there which enables them to deal with, as formerly, all boiler repairs, gas, electric and acetylene welding, in addition to all engine work previously undertaken.

COLONEL R. E. CROMPTON informs us that he has entered into partnership with Dr. Alfred Ekstrom, a member of the Institution of Electrical Engineers, who has specialised in the problems of applying electrical energy to agriculture in Sweden. The partnership will act as consultants on similar matters in the United Kingdom and in the British Dominions and Colonies.

CONCRETE RAFTS FOR FLATS.—In the construction of flats at Manor-road and Star-lane, West Ham, it was found desirable to use reinforced concrete rafts upon which the brick walling could be directly erected, and the "Trestle" system of the Weston Concrete Engineering Company, Ltd., West Norwood, is being employed for the purpose. In this system a connector steel of very light section is employed between the top and bottom layers of tension steel. We are informed that it weighs barely 1 lb. per yard super, or not more than 3·5 per cent. of the total weight of the reinforcement. Yet the construction is so rigid that workmen may walk about upon boards laid directly upon the reinforcement when placing the concrete.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 22/–
(1) Spanish	24/–
(1) N. African	24/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	24/9

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 0 0	—
No. 1 Foundry	3 18 6	—
No. 3 Foundry	3 16 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 16 0	3 16 0
No. 1	3 16 6	3 16 6
Cleveland—		
No. 1	3 15 0	3 15 0
Silicious Iron	3 15 0	3 15 0
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 11 6
No. 4 Forge	3 11 0	3 11 0
Mottled	3 10 6	3 10 6
White	3 10 6	3 10 6
MIDLANDS—		
(3) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 11 0	—
„ „ Foundry	3 13 6	—
(3) Northampton—		
Foundry No. 3	3 12 6	—
Forge	3 8 6	—
(1) Derbyshire—		
No. 3 Foundry	3 16 0	—
Forge	3 12 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 12 6	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 5 6 (*a*) / 4 7 6 (*b*) / 4 11 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 15 0	—
Second Quality Bars	9 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ⅜in. and up	8 12 6	7 12 6
Sections	8 2 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 7 6
Sheets (Gal. Cor. 24 B.G.)	13 17 6	13 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 12 6	—
Angles	8 2 6	—
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 2 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 2 6	—
„ (Small Round)	8 5 0 to 8 7 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	7 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	8 10 0	—
MIDLANDS—		
Small Rolled Bars	8 5 0 to 8 15 0	—
Billets and Sheet Bars	6 10 0 to 6 15 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 7 6 to 13 10 0	—
Angles	8 2 6	—
Joists	8 2 6	—
Tees	9 2 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/6 to 18/9
Block Tin (cash)	204 5 0
„ „ (three months)	208 7 6
Copper (cash)	75 12 6
„ (three months)	76 6 3
Spanish lead (cash)	23 6 3
„ „ (three months)	23 11 3
Spelter (cash)	24 7 6
„ (three months)	24 17 6
MANCHESTER—	
Copper, Best Selected Ingots	81 5 0
„ Electrolytic	85 5 0
„ Strong Sheets	110 0 0
„ Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
„ Condenser, lb.	0 1 3
Lead, English	24 17 6
„ Foreign	23 12 6
Spelter	25 0 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/6¼ per lb.	
Ferro Tungsten	3/3½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	7/6
„ „ 6 p.c. to 8 p.c.	£23 0 0	7/–
„ „ 8 p.c. to 10 p.c.	£23 0 0	6/6
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£34 0 0	12/–
„ „ „ 1 p.c. carbon	£38 0 0	15/–
„ „ „ 0·70 p.c. carbon	£42 0 0	17/–
„ „ „ carbon free	1/2 per lb.	
Metallic Chromium	2/6 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
„ „ 75 p.c.	£19 10 0 scale 6/– per unit	
„ Vanadium	13/– per lb.	
„ Molybdenum	4/– per lb.	
„ Titanium (carbon free)	1/– per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/4 per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/–
„ „ Ell	15/3
„ „ Splint	16/6 to 18/–
„ „ Trebles	16/–
„ „ Doubles	15/–
„ „ Singles	13/– to 13/6
AYRSHIRE	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	16/–
„ „ Trebles	16/–
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	12/– to 15/6
Screened Navigation	17/6 to 18/6
Trebles	16/6 to 17/6
Doubles	15/6
Singles	13/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/–
Secondary Steam	13/6
Trebles	17/–
Doubles	15/6
Singles	13/– to 13/6

ENGLAND.

	Export.
(8) N.W. COAST—	
Steams	21/6 to 22/–
Household	38/– to 51/–
Coke	26/6 to 27/6
NORTHUMBERLAND—	
Best Steams	15/9 to 16/–
Second Steams	14/6 to 14/9
Steam Smalls	9/6 to 10/6
Unscreened	13/– to 13/6
Household	21/– to 26/–
DURHAM—	
Best Gas	17/–
Second	15/6 to 16/–
Household	21/– to 27/–
Foundry Coke	25/– to 30/–

SHEFFIELD	Inland.	
Best Hand-picked Branch	25/6 to 28/–	—
Derbyshire Best Bright House	21/– to 23/–	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	18/6 to 20/–	—
„ „ Nuts	16/6 to 18/–	—
Yorkshire Hards	14/6 to 15/6	—
Derbyshire Hards	14/6 to 15/6	—
Rough Slacks	9/– to 10/–	—
Nutty Slacks	7/– to 8/–	—
Smalls	3/– to 5/–	—
Blast-furnace Coke (Inland)	14/6 at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		22/– to 23/–

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/9 to 20/3
Second Smokeless Large	19/6 to 19/9
Best Dry Large	18/9 to 19/–
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/– to 18/3
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/9 to 18/–
Ordinary Eastern Valley Large	17/3 to 17/9
Best Steam Smalls	13/9 to 14/6
Ordinary Smalls	12/6 to 13/–
Washed Nuts	22/6 to 28/–
No. 3 Rhondda Large	20/– to 21/–
„ „ Smalls	15/6 to 16/–
No. 2 „ Large	17/– to 17/6
„ „ Through	15/6 to 16/6
„ „ Smalls	13/6 to 14/–
Foundry Coke (Export)	26/6 to 36/6
Furnace Coke (Export)	21/– to 23/–
Patent Fuel	21/6
Pitwood (ex ship)	35/– to 36/–
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	33/– to 36/6
Seconds	27/6 to 30/–
Red Vein	23/– to 27/–
Machine-made Cobbles	40/– to 44/–
Nuts	40/– to 44/–
Beans	23/6 to 25/6
Peas	19/– to 19/6
Breaker Duff	9/6 to 9/9
Rubbly Culm	11/3 to 11/9
Steam Coals :	
Large	18/– to 19/–
Seconds	17/– to 18/–
Smalls	11/3 to 13/–
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum) 12/6

Ordinary Ship, Bridge and Tank Plates and Sections 10/– if home consumers confine purchases from associated British Steel Makers.

French Engineering Notes.

(From our Correspondent in Paris.)

The Navy.

THE proposals for a limitation of naval armaments have not retarded the carrying out of the French programme of naval construction. The French are reluctant even to consider any such proposals as practical under present conditions, and will make any question of disarmament dependent upon arrangements for ensuring absolute security. Although it will be another five or six years before the existing programme of naval construction is completed, the reconstitution of the fleet is already well advanced, and the appointment of a new command to the Mediterranean fleet has called attention to the progress already achieved, particularly in the creation of divisions of light and fast vessels. Under the special conditions of strategy imposed in the Mediterranean the main essential has been to attain speed with a concentration of fire, and with the light and fast cruisers, submarines, destroyers, torpedo boats and aircraft, the French believe that they are in a fair way of attaining their end. There are three battleships in the Mediterranean, including the flagship "Bretagne," and others are being refitted, but they are in no sense modern vessels and are not regarded as constituting a real factor of defence. On the other hand, the light division is particularly efficient. At present there are three cruisers and three big destroyers, and before long this division will be reinforced by the addition of the "Tourville," which is one of the most powerful and the most rapid of the 10,000-ton class. The new destroyers "Guépard" and "Valmy" will be attached to the Mediterranean fleet. They are said to be the largest and fastest vessels of the kind afloat. The "Valmy's" speed very nearly reached 40 knots. There are twelve torpedo-boats of the "Orage" class of 1450 tons and seven of the "Palme" class of 1495 tons. To the Mediterranean fleet has been attached the "Béarn," seaplane carrier which has given a good account of itself in recent manœuvres, although it represents the transformation of a 22,000-ton battleship which was left on the stocks during the war. The newest seaplane carrier, "Commandant Teste," has some resemblance to the 10,000-ton cruisers. Its engines will develop 21,000 horsepower, and it will steam at 20 knots. The aircraft are launched from the deck by catapult.

Electrical Production.

The statistics of the production and distribution of electricity in France compiled by the Syndicat Professionnel de la Chambre Syndicale des Forces Hydrauliques and by the Comité d'Électricité show that the energy produced increased from 7490 million kWh in 1923 to 11,875 million kWh in 1927. Of the latter total the electrochemical industries absorbed 9260 million kWh. In the Paris district alone the production last year was 1796 million kWh, nearly one-half of which was produced by the Union d'Electricité, mainly at its power station at Gennevilliers. A still more powerful station with a capacity of 400,000 kW is being constructed at Vitry, and will probably be in operation towards the end of next year. The Union d'Electricité aims at a concentration of electrical distribution, and while the Gennevilliers station is being connected up with the Eguzon hydro-electric power installation in order to avoid any interruption of supply to the Paris-Orleans railway, the Union possesses practically a monopoly of electrical distribution in the Paris suburbs. The Compagnie Parisienne de Distribution d'Electricité holds a concession from the town of Paris and is under municipal control. The consumption in Paris has grown so considerably that it has been found necessary to carry out a big programme of extensions, notably in increasing the distributing system in the centre of Paris, and constructing sub-stations for the energy which will be available eventually from the hydro-electric sources of supply.

Cooling Railway Coaches.

During the recent tropical weather conditions railway travelling in the day time was so uncomfortable that passengers preferred to journey by night. The Paris-Orleans railway company as an outcome carried out an experiment for keeping the coaches at a sufficiently low temperature to allow of passengers to travel in comfort. The experiment proved to be a pronounced success. The roof of the coach was covered by a white awning which appreciably reduced the temperature inside. In addition, a cooling arrangement was installed consisting of a means for forcing air through an ice box and thence, after filtration, through pipes into each compartment. In order to avoid too sudden a change from the extremes of temperature the corridors were not cooled. The result was so far satisfactory from the point of view of comfort in particularly hot weather, that there is every prospect of the system being extended on the Paris-Orleans railway.

Underground Cables.

Within a short period the whole of the trunk telephone and telegraph lines in France will be laid underground. During the past week the line, which had already been working between Paris and Lyons, was officially opened to Marseilles, a distance of 506 miles. In order to provide an extensive system of communication by circuits the cable is built up of 364 copper wires, and amplification is obtained by relay stations, the result being that telephonic communication between Paris and distant towns is now remarkably good. The lines to Strasburg and Lille are placed underground, and before long similar lines will be completed to Bordeaux. This development is greatly facilitated by the fact that on each side of the main or national roads there are more or less wide spaces belonging to the State, and it was easy to make trenches with tractors and ploughs, to concrete the trenches where necessary, and to provide the necessary means of inspection. The work is a great one, and has been carried out with considerable enterprise, with the result that the Post Office department has recovered some of the reputation it has been in danger of losing through the inefficient character of the telephone system.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

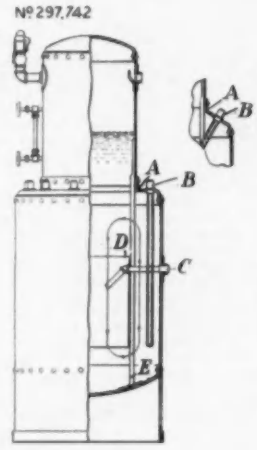
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

297,742. September 25th, 1928.—ELECTRIC STEAM GENERATORS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

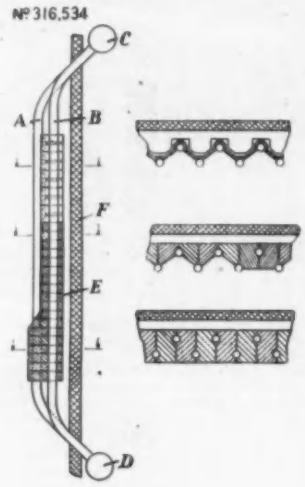
An electric steam generator constructed in accordance with this invention consists of a lower portion and a considerably smaller upper portion. There is also an intermediate horizontal offset portion A connecting the upper and lower parts with



electric heating elements B projecting downwards into the interior of the lower portion. Water is supplied to the boiler through a feed pipe C. In order to promote circulation a cylindrical baffle member D is mounted on supports E. The small drawing shows a slightly modified form of construction in which the flange portion A is inclined and the heaters B are consequently also inclined.—*August 8th*, 1929.

316,534. April 30th, 1928.—WATER-COOLED FURNACE WALLS, Babcock and Wilcox, Ltd., of Babcock House, Farringdon-street, London, E.C. 4, and Jacobus Boerstra, of 72, Verspronkweg, Haarlem, Holland.

This specification describes an improved construction of water cooled furnace walls, in which there are two rows of tubes, both in heat-conducting contact with the wall, and staggered in relation to each other. The tubes are fixed into a top and bottom

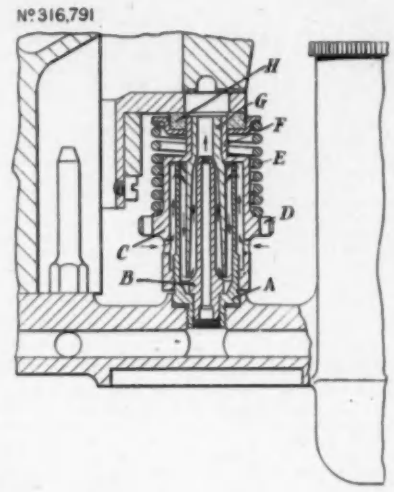


header, and there is an air space between the inner row of tubes and the boiler casing. The left-hand drawing shows the two rows of tubes A and B extending into the upper and lower headers C and D, with the air space E between the tube B and the boiler casing F. The right hand drawings show different arrangements of brickwork and cast iron blocks into which the tubes may be fixed.—*July 30th*, 1929.

INTERNAL COMBUSTION ENGINES.

316,791. August 25th, 1928.—CARBURETTERS FOR INTERNAL COMBUSTION ENGINES, Bentley Motors, Ltd., and Thomas Tomlins, of Oxgate-lane, Cricklewood, Middlesex.

This invention relates to carburetters having a slow running fuel feed device, which is claimed to be easily adjustable and silent in operation. From the accompanying drawing it will be seen that there is an upstanding sleeve A into which is screwed the fuel nozzle B. The sleeve is carried up to the top of the fuel nozzle, and is screwed on its lower periphery. Upon the threaded portion there is fitted the cylinder C, which is furnished with a knurled collar D, and is fixed in the desired position by the pressure of the spring E. The upper end of the cylinder terminates in a neck F, through which the slow-running mixture enters, and into this neck is fitted the shroud G. By screwing the cylinder C up or down, the distance between the shroud and the tip of the fuel nozzle is varied, and the mixture so regulated. The arrows show the direction of the air stream, and it is claimed that the tortuous passages act as a silencer. Between the upper end of the cylinder and the housing there is a packing ring H,



which is compressed by the spring and prevents any leakage past the upper end of the cylinder.—*August 8th*, 1929.

DYNAMOS AND MOTORS.

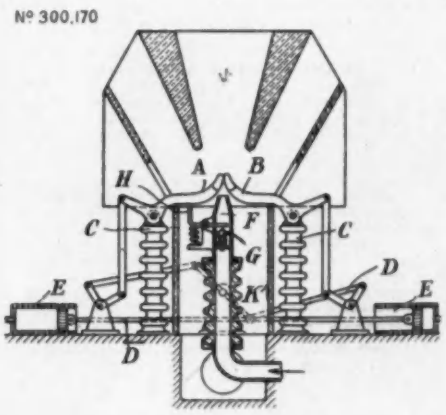
300,237. October 26th, 1928.—DOUBLE SQUIRREL-CAGE MOTORS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemenstadt, Germany.

In accordance with this invention, one of the squirrel-cage windings in a double squirrel-cage motor of the Boucherot type is separated from the other winding by intermediate members of magnetic material, and the cross-sectional area of the intermediate members is such that the induction in them lies between 20,000 and 28,000 lines of force per square centimetre. It is explained that if the induction is higher than 28,000 there will be insufficient leakage during starting of the squirrel-cage winding acting as the running winding and the starting torque will be too small, whereas if the induction is less than 20,000 there will be too much leakage during running and a bad efficiency will result.—*August 8th*, 1929.

SWITCHGEAR.

300,170. October 5th, 1928.—HIGH-TENSION ELECTRIC SWITCHGEAR WITH ARC EXTINGUISHING BY COMPRESSED AIR, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemenstadt, Germany.

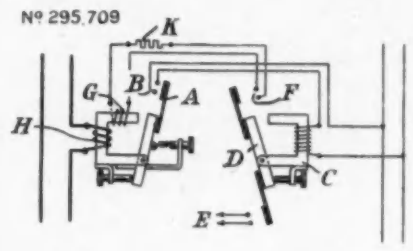
An example of an arrangement of the invention is shown in the accompanying drawing. The two contacts shown at A and B are free to turn on the insulating supports C. The switchgear is operated through a rod system D from two compressed air



cylinders E, the air supply to which is automatically regulated in accordance with the strength of the current. The air-conducting nozzle F, which carries the air for extinguishing the arc, is arranged closely underneath the closed position of the two contacts, and is provided with a valve G which is directly controlled through a lever H by the movement of the contacts. The air nozzle F is surrounded by a glass tube K which acts as an air shaft for the additional air supplied by a fan.—*August 8th*, 1929.

295,709. July 19th, 1928.—LIMIT-CURRENT ELECTRIC RELAYS FOR CONTROLLING SWITCHING OPERATIONS, Maschinenfabrik Oerlikon, of Oerlikon, near Zurich, Switzerland.

This invention relates to limit-current relays for controlling switching operations of the kind in which the relay magnet, in



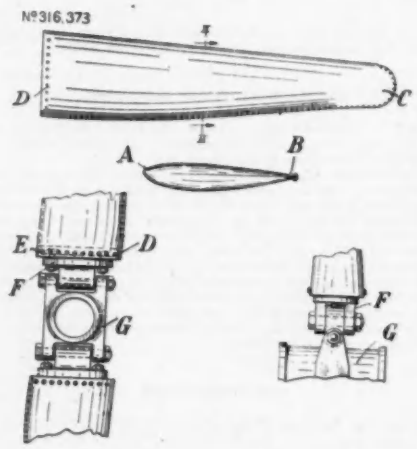
addition to its main magnetising winding, has an oppositely wound auxiliary winding which is energised when the relay armature is attracted and which diminishes the attractive force of the magnet, so enabling the magnet to release the armature,

on a slight reduction of the current traversing the main winding. By delaying the closure of the circuit of the auxiliary winding until after completion of the travel of the armature towards the magnet the setting of the lower release current limit is rendered independent of wear on the contacts of the circuit of the auxiliary winding. The illustration shows a relay for alternating current, which operates between two narrowly limited current values. Shortly before its end or final position the armature A closes the contacts B and thus completes the circuit of the auxiliary magnet C, the armature D of which closes the contacts E and F. The contacts E are in the circuit to be controlled, whilst the contacts F complete the circuit of an auxiliary winding energised by induction, and this winding acts in opposition to the main winding H. By means of a resistance or choke coil K the induced current in the auxiliary winding can be regulated until the desired release limit of the armature A or D is attained without chattering. The conditions for the auxiliary winding G are so selected that the armature A, when once attracted, remains in that position, but the tractive force decreases in such a way that the armature drops again when a slight diminution of current takes place in the main winding. The armature D follows each stroke of the magnet armature A, and since the auxiliary magnet C is either energised or dead, it may develop a relatively high attractive force.—*August 8th*, 1929.

AERONAUTICS.

316,373. May 23rd, 1928.—PROPELLERS, Sir W. G. Armstrong, Whitworth Aircraft, Ltd., and Frederick Michael Green, both of Park Side, Coventry.

This invention has for its object the production of a metal airscrew which, it is claimed, is light in weight and yet possesses considerable strength. The blade of the aircrew is formed by a single sheet of metal A folded over itself and secured at the trailing edge B and the tip C. The construction will be clearly

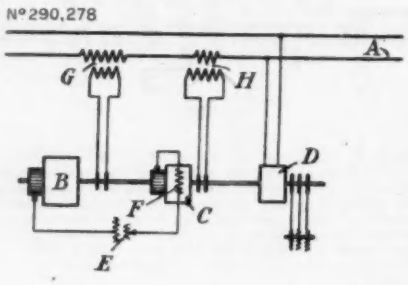


seen from the engravings. The root of the blade D is closed by an end piece E of channel section to which the walls of the blade are secured. This end piece is further secured to the trunnion fitting F, by which it is attached to the airscrew hub G. Alternative forms of attachments to the hub are shown, provision being made in each case to allow the blade to be twisted angularly in order that the desired pitch of blade may be obtained before the final fastening is made.—*August 1st*, 1929.

TRANSMISSION OF POWER.

290,278. April 26th, 1928.—ARRANGEMENT FOR INTRODUCING VOLTAGES INTO ALTERNATING-CURRENT CIRCUITS, *Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.*

This specification describes an arrangement for the injection of voltages of any desired value and phase into alternating-current circuits, wherein it is easily possible to regulate either the value or the phase of these voltages. A is an alternating-current transmission line, the ohmic or inductive potential drop of which is proportional to the current, and it is proposed to compensate this drop by the automatic injection of a boosting

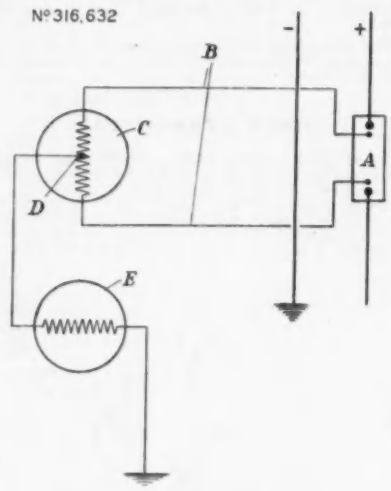


voltage. For that purpose two alternating frequency changers B and C are provided, which are coupled together and are driven by an asynchronous motor D. The frequency changers are connected in series through their commutators and through a transformer E. The frequency changer C is provided with a compensating winding F. The collecting rings of the respective frequency changers are connected to the two transformers G and H in the alternating-current circuit A. By a suitable dimensioning of the number of turns the windings in the line A act as a primary winding in the case of transformer H and as a secondary winding in the case of transformer G.—*April 26th*, 1929.

MEASURING AND TESTING INSTRUMENTS.

316,632. March 29th, 1928.—ELECTRICAL MEASURING INSTRUMENTS AND CIRCUIT ARRANGEMENTS FOR USE THEREWITH, William Phillips, of 37, Belmont-hill, Lee, Kent; and Elliott Brothers (London), Ltd., of Century Works, Lewisham, S.E. 13.

This invention is particularly applicable to systems embodying automatic and semi-automatic sub-stations, and in general to systems wherein it is required to indicate, measure or record current and voltage values at situations comparatively remote from the circuits in which the currents and voltage occur. The invention has for its principal object to reduce to a minimum the number of pilots or connections. A is a shunt connected in the positive bus-bar and B are pilot wires led from the ends of the shunt to a moving coil direct-current ammeter C situated at the place at which the values are to be indicated. The ammeter winding is provided with an accessible centre tap D to which one terminal of a high-resistance direct-current voltmeter E—preferably an instrument of the same type as the ammeter—is connected, the other terminal of the voltmeter being connected to earth. Where the negative pole of the system is not earthed the voltmeter circuit is completed by a third pilot wire back to the negative bus-bar. If desired, the third wire may, of course,

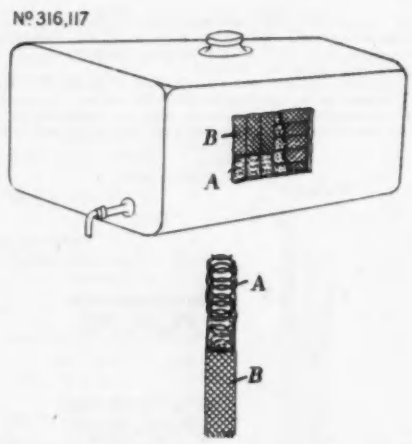


be provided in any case. It will be seen that with this arrangement, since the current taken by the voltmeter passes through the two parts of the ammeter winding in opposite directions, it will have substantially no effect upon the reading of the ammeter and can therefore be in or out of circuit, as may be required, while, assuming the voltmeter resistance to be sufficiently high relative to the ammeter and pilot wire resistances, the voltmeter reading will be substantially unaffected should the ammeter be removed at any time, the positive terminal of the voltmeter being, of course, connected to one of the ammeter pilot wires, should it be desired to remove the ammeter.—*July 29th*, 1929.

MISCELLANEOUS.

316,117. April 23rd, 1928.—PETROL TANKS FOR AEROPLANES AND MOTOR CARS, William Thomas Caddy, of "Waratah," Effingham-road, Surbiton, Surrey; and David Doig, of 174, New Bond-street, London.

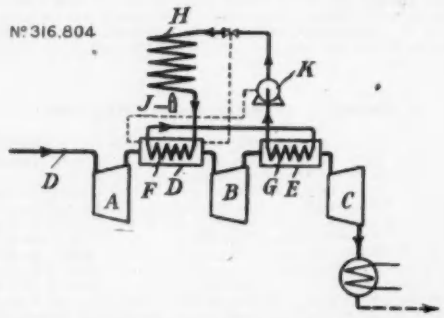
A tank or vessel constructed according to this invention is made of flexible walls which consist of inner and outer laminæ of textile fabric, and intermediate laminæ of bands or ribbons made of flattened metal wire coils served with rubber, so as to fill the interstices of the metal, and laid side by side and secured



together, the rubber being pressed to embed the metal-flattened coil in it. The laminæ are pressed to form sheets, the sheets so formed being used and shaped so as to form the tank or hollow vessel; the whole being vulcanised when built up. A represents the ribbons or bands of flattened spiral coils, the interstices of which are filled up with the unvulcanised rubber, in which they are embedded and which may be pressed or rolled in or on the flattened wire bands or strips. The diaper work B represents ordinary braided textile threads which extend helically round the rubber bands or ribbons.—*July 29th*, 1929.

316,804. September 17th, 1928.—STEAM POWER PLANT WITH INTERMEDIATE SUPERHEATING, Siemens-Schuckertwerke Aktiengesellschaft, Berlin-Siemensstadt, Germany, and Hans Gleichmann, of 26, Wendtpromenade, Falkenheim, near Spandau, Germany.

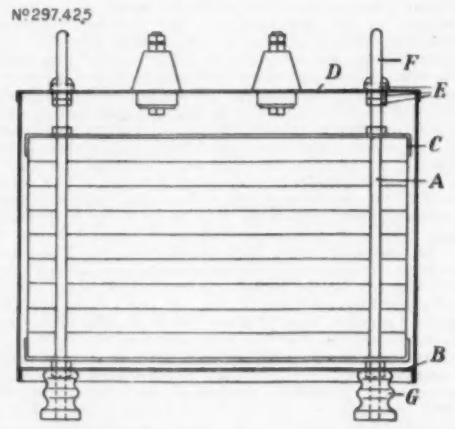
In this specification a method of intermediate superheating is



disclosed, the special feature being that steam of at least the critical pressure and at least the critical temperature is used as the heat furnishing medium, this being referred to in the following description as "limit" steam. This method of intermediate superheating is claimed to offer important advantages. As a result of its great density, limit steam gives a good heat transfer. The power unit with stages A, B, and C, is supplied with the usual fresh steam from the supply D. Between stages the A B and B C heat transfer chambers D and E are placed, to which heat is supplied through the coils F and G. The limit steam is generated in a pipe system H, which is heated by a burner J. The limit steam travels in a circuit consisting of the pump K, the pipe system H, and the two coils F and G, in which the limit steam flows in the opposite direction to the superheated steam. The plant can be regulated in accordance with the fluctuating conditions of the working steam in either of the two heat transfer chambers. —*August 8th*, 1929.

297,425. September 15th, 1928.—ELECTRIC CONDENSER, Elektrizitäts-Aktiengesellschaft Hydrawerk, of 18, Windscheidstrasse, Berlin-Charlottenburg, Germany.

The purpose of this invention is to provide large condensers suitable for power factor correction with lighter cases than have hitherto been permissible. The object is, of course, to reduce the cost and weight. The bolts A hold the condenser



together, and pass through the base plate B, the top cover C, and the cover plate D, where there are nuts E. The upper ends of the bolts are provided with lifting rings F for carrying the condenser, so that during transport the weight of the body of the condenser is transferred directly to the rings F through the bolts B. The construction of the case may therefore be quite light. The bolts may also be used for attaching the insulators G to the case.—*August 8th*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

IRON AND STEEL INSTITUTE.—Autumn meeting at Newcastle-on-Tyne.

TO-DAY AND SATURDAY, SEPTEMBER 14TH.

MODEL ENGINEER EXHIBITION, Royal Horticultural Hall, Vincent-square, Westminster, London, S.W. 1.

TO-DAY TO SATURDAY, SEPTEMBER 28TH.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION, Olympia.

SATURDAY, SEPTEMBER 14TH.

INSTITUTION OF ENGINEERS-IN-CHARGE.—Official visit to the Shipping, Engineering and Machinery Exhibition, Olympia.

SATURDAY TO SATURDAY, SEPTEMBER 14TH TO 28TH.

INSTITUTION OF NAVAL ARCHITECTS.—Summer meeting in Italy. For programme see page 380, April 5th, 1929.

WEDNESDAY, SEPTEMBER 18TH.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Visit to Scar House Reservoir, Nidd Valley, Bradford Corporation Waterworks. Meet at the Engineer's office on the site from 2.15 to 2.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS: BIRMINGHAM BRANCH.—Windsor Room, Grand Hotel, Colmore-road, Birmingham. "Progress in Manufacturing Practice," by Mr. J. H. Garnett. 7 p.m.

FRIDAY, SEPTEMBER 20TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—North-Western District meeting at Bebington and Bromborough, Cheshire. Assemble at Hulme Hall, Port Sunlight, 11 a.m. Paper on "Development and Works in the Bebington and Bromborough District," by Mr. Percy Parr.

FRIDAY AND SATURDAY, SEPTEMBER 20TH AND 21ST.

INSTITUTION OF WATER ENGINEERS.—Informal autumn meeting. Visits to the works of the Wakefield and Barnsley Corporations.

FRIDAY AND SATURDAY, SEPTEMBER 27TH AND 28TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Institution meeting to be held in the Isle of Ely.

WEDNESDAY, OCTOBER 16TH.

OVERHEAD LINES ASSOCIATION.—At the Institution of Electrical Engineers, Savoy-place, London, W.C. 2. Annual general meeting. 5.30 p.m.

THURSDAY, NOVEMBER 21ST.

BRITISH WATERWORKS ASSOCIATION.—Public Works Congress at the Agricultural Hall, London. Papers: "Water Supply as a Factor in Town and Regional Planning," by Mr. G. L. Pepler, F.S.I.; "The Preservation of Rivers and Streams from the Standpoint of Water Supply: Some Observations on River Pollution," by Dr. J. B. Firth; "The Purity of Drinking Waters from a Biological Aspect," by Dr. W. Rushton.